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LEVEL III (13)

M-X
ENVIRONMENTAL
TECHNICAL REPORT

ETR 10
NOISE

Unclassified

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READ INSTRUCTIONS BEFORE COMPLETING FORM

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20. ABSTRACT (*Continue on reverse side if necessary and identify by block number*)

The construction and operation of the M-X system will produce two potentially major sources of noise and consequent impact on the environment:

1. Highway traffic near the bases and within the M-X system.
2. Airfield operation associated with the bases.

Secondary sources of noise include:

1. Construction activities
2. Railroad traffic transporting materials to the sites

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during construction.

The purpose of this analysis is to establish on a general level the impacts associated with these noise sources, and to suggest mitigation methods where applicable.

M-X ETR-10

ENVIRONMENTAL CHARACTERISTICS OF ALTERNATIVE DESIGNATED DEPLOYMENT AREAS: TECHNICAL REPORT ON NOISE

Prepared for

U.S. Air Force
Ballistic Missile Office
Norton AFB, California

By

Henningson, Durham & Richardson Sciences
Santa Barbara, California

22 December 1980

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1.0 INTRODUCTION

The construction and operation of the M-X system will produce two potentially major sources of noise and consequent impact on the environment:

1. Highway traffic near the bases and within the M-X system
2. Airfield operation associated with the bases.

Secondary sources of noise include:

1. Construction activities
2. Railroad traffic transporting materials to the sites during construction.

The purpose of this analysis is to establish on a general level the impacts associated with these noise sources, and to suggest mitigation methods where applicable.

1.1 EFFECTS OF NOISE

The effects of noise can generally be classified into three categories:

1. Subjective effects such as annoyance and nuisance.
2. Interference with activities such as speech communications, work, education, and sleep.
3. Physiological effects such as loss of hearing and stress related problems including nervousness and high blood pressure.

Appendix A presents graphically the effect of noise on annoyance levels, sleep interference and speech communication interference.

Excessive noise and vibration can also cause physical damage to buildings and other structures.

1.2 NOISE MEASUREMENT

The magnitude of noise generation is often described in terms of sound pressure level, the basic unit being the decibel or dB. Because of the great range of sound pressures humans are capable of hearing, a logarithmic scale is used. Figure 1.2-1 illustrates approximately the relationship between subjective loudness and sound pressure levels. Figure 1.2-2 illustrates the variations in noise in a suburban neighborhood. In Table 1.2-1 a list of the sound pressure levels for common noises is given.

Humans do not hear all sound frequencies equally. In order to obtain a valid relationship between what we hear and sound measurements, a filter known as the A-weighting network is often used to discriminate against low and very high frequencies. The resultant measurement is referred to as the A-weighted sound level in units designated as dBA.

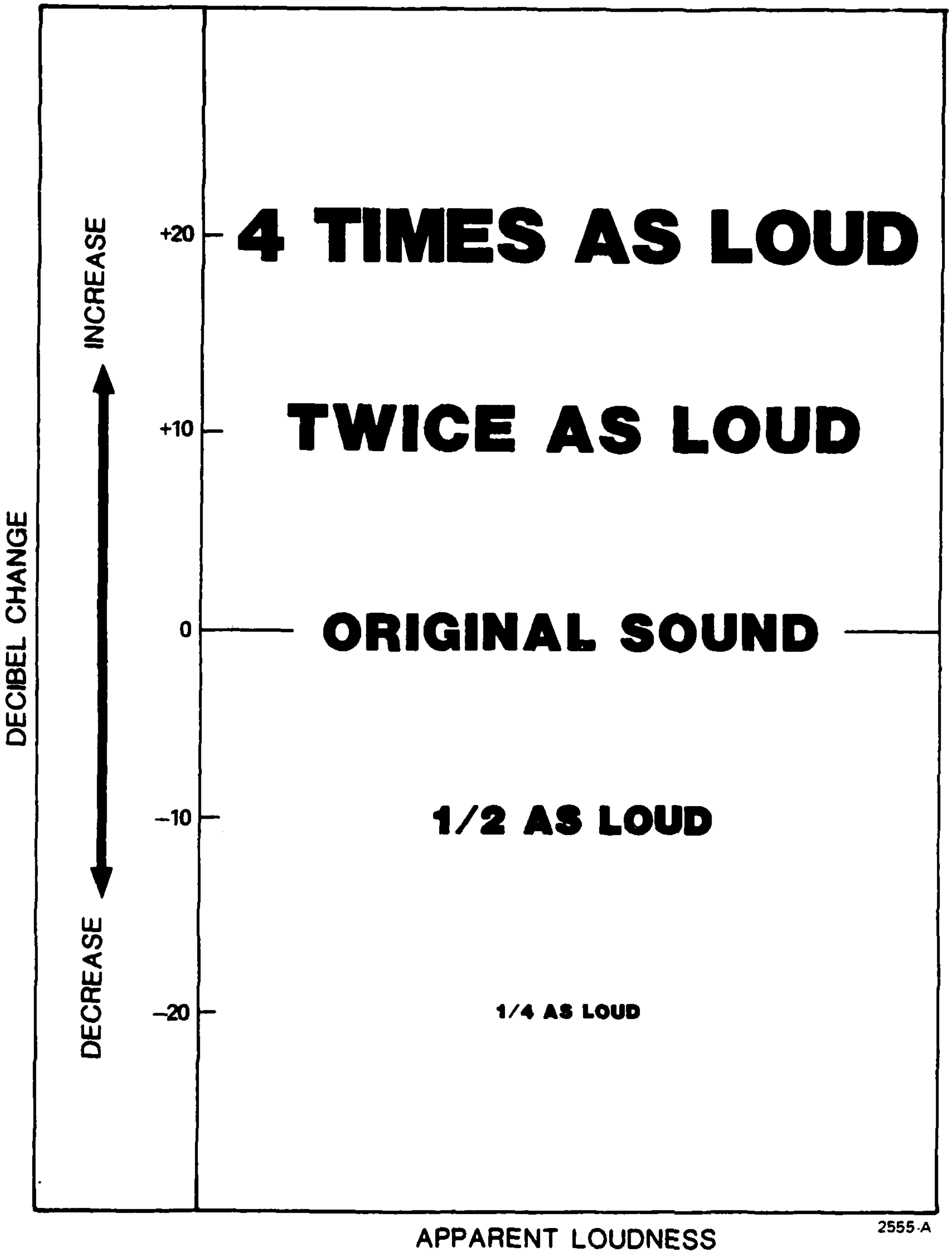

Figure 1.2-1. Apparent loudness as a function of decibel change.

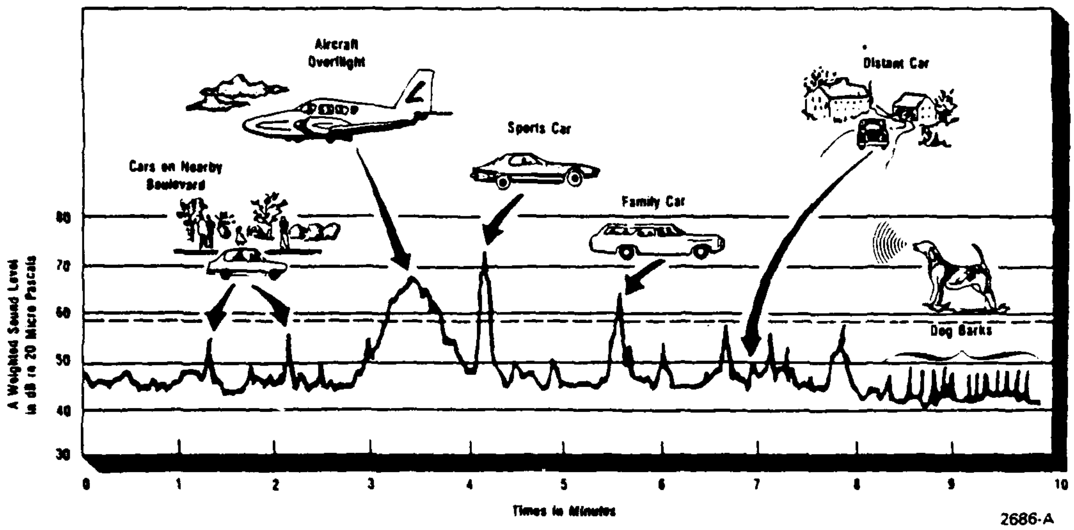

Figure 1.2-2. Typical outdoor sound measurement on a quiet suburban street.

Table 1.2-1. Common noise levels.

dBA	COMMON NOISE LEVELS
130	THRESHOLD OF PAIN
120	CHIPPING ON METAL
110	ROCK BAND
100	JACKHAMMER
	JET TAKEOFF (1/2 MILE)
90	THRESHOLD OF HEARING DAMAGE
	MOTORCYCLE (URBAN RESIDENTIAL)
80	
	BUSY FREEWAY
70	ICE CREAM TRUCK WITH MUSIC (URBAN RESIDENTIAL)
	POWER LAWN MOWER (URBAN RESIDENTIAL)
	CHILDREN PLAYING (URBAN RESIDENTIAL)
60	NORMAL CONVERSATION
50	RADIO PLAYING MUSIC (URBAN RESIDENTIAL)
	BIRD (NORMAL SUBURBAN AREA)
40	SUBURBAN NEIGHBORHOOD (DISTANT TRAFFIC)
30	
20	QUIET RURAL AREA (NO TRAFFIC)
10	
0	THRESHOLD OF AUDIBILITY

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Different noise metrics have been developed for reporting various noise situations because of the time periods and averaging methods used in the measurements and the nature of noises under investigation. Examples of these are the equivalent continuous sound level (L_{eq}), the day-night average sound level (L_{dn}), and the percentile exceeded sound level (L_x). A list of definitions is provided in Appendix B.

For traffic noise levels, the equivalent continuous sound level, L_{eq}, is given for the peak hour of traffic.

For airports the day-night average sound level, L_{dn}, is used. This average penalizes sounds made at night between 10 p.m. and 7. a.m. by adding 10dB to sounds during that period.

A second aircraft metric, the Noise Exposure Forecast (NEF) has seen widespread use. However, its use involves a complex measurement scheme and as a result, the more straight forward L_{dn} metric has now been adopted by HUD and other agencies.

Situations may arise in which an area is exposed to more than one noise source. Under these circumstances, the combined effect of the multiple sources is determined by adding logarithmically the contributions from all sources. This is applicable only for long-term average type noise metrics such as L_{dn} or L_{eq}. All sources contributions must be represented by the same metric. The following formula is used:

L total = 10 log $10^{Li/10}$ where L_i is a single sound source

As a result of this logarithmic method of dBA summation, when two sound levels are added and one is 5 dBA greater than the other, the overall sound level is only 1.2 dBA higher than the greater source.

1.3 REGULATIONS AND STANDARDS

Various agencies of the federal, state and local governments are concerned with regulations and standards concerning noise. The Environmental Protection Agency (EPA) is the primary reviewer of all federal noise activities and also oversees vehicle noise limits. The Department of Housing and Urban Development (HUD) is involved with establishing noise exposure standards for residential construction. None of the states where the M-X system is being considered has noise regulations. In general, local governments use the federal regulations as guidelines for their own noise control policies.

1.3.1 Traffic Noise Regulations

The Federal Highway Administration (FHWA) is responsible for setting noise standards for the location of new highways. Table 1.3.1-1 presents the current guidelines. According to HUD regulations for typical traffic distributions, the one hour peak L_{eq} is approximately equivalent to L_{dn}. (Ref. HUD 24 CFR Part 51.106(a) (2)).

The FHWA design levels for residences are shown as L_{dn} 67. However, the HUD criterion for noise exposure in residential neighborhoods is L_{dn} 65 (Ref. HUD

Table 1.3.1-1. Design noise levels representing the upper limit of acceptable highway traffic noise levels.

ACTIVITY CATEGORY	DESIGN NOISE LEVELS* dB		DESCRIPTION OF ACTIVITY CATEGORY
	L_{eq}	L_{10}	
A†	57 (Exterior)	60 (Exterior)	Tracts of land in which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Such areas could include amphitheaters, particular parks or portions of parks, open spaces, or historic districts which are dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet.
B†	67 (Exterior)	70 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, and parks which are not included in Category A and residences, motels, hotels, public meeting rooms, schools, churches, libraries, and hospitals.
C	72 (Exterior)	75 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	—	—	Undeveloped lands.
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

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*L_{eq} is the symbol for equivalent continuous sound level; L_{10} is the symbol for 10-percentile exceeded sound level. Either L_{eq} or L_{10} (but not both) design noise levels may be used on a project.

†Parks in Categories A and B include all such lands (public or private) which are actually used as parks as well as those public lands officially set aside or designated by a government agency as parks on the date of public knowledge of the proposed highway project.

24 CFR 52.103(c)), and some state and local regulations use L_{dn} 60 as the criterion. For purposes of this study, impacts will be determined on the basis of the HUD (L_{dn} 65) criterion.

1.3.2 Airport Noise Regulations

The Federal Aviation Administration (FAA) establishes noise standards for aircraft and sets measures of noise standards around airports.

In 1972 the Air Installation Compatible Zone (AICUZ) concept was established as a method to protect local citizens from noise and accident hazards associated with flying activities in the interest of their health, safety and general welfare, and also to preserve the operational integrity of airfields. Applications of the AICUZ method and its acceptance by local communities indicate that it is a rational basis for airfield environs compatible land use planning.

This concept is a system for identifying and assessing land use compatibility and its suitability for use near an airfield operation. Part of the AICUZ methodology is to develop noise zones produced by computerized Day-Night Average Sound Level (L_{dn}) contouring programs.

Nearly all studies on residential/aircraft noise compatibility recommend no residential uses in noise zones above Day-Night Average Sound Level (L_{dn}) 75. Usually no restrictions are recommended below L_{dn} 65. Between L_{dn} 65-75 there is currently no consensus with special noise control construction required for approval in most areas. However, wherever possible, residential use should be located below L_{dn}65 which is consistent with the HUD criterion.

Most industrial/manufacturing uses are compatible in the airfield environs. Exceptions are uses, such as research or scientific activities, which require lower noise levels. Noise level reduction measures are recommended for portions of buildings devoted to office use, receiving the public or where the normal background noise level is low.

The transportation, communications and utilities categories have a high noise land compatibility because except for construction and maintenance these areas are not populated.

Commercial/retail trade and personal and business services categories are compatible without restriction up to L_{dn} 70; however, they are generally incompatible above L_{dn} 80. Between L_{dn} 70-80, noise level reduction measures should be included in design and construction of buildings.

The nature of most uses in the public and quasi-public services category requires a quieter environment, and attempts should be made to locate these uses in areas with a L_{dn} below 65, or else provide adequate noise level reduction measures.

Although recreational use has often been recommended as compatible with high noise levels, recent research has resulted in a more conservative view. Above L_{dn} 75, noise becomes a factor which limits the ability to enjoy such uses. Where the requirement to hear is a function of the use (music shell, etc.), compatibility is limited. Buildings associated with golf courses and similar uses should be noise attenuated.

With the exception of forestry activities and livestock farming, uses in the resource production, extraction and open space category are compatible almost without restriction. However, in extreme cases, the effects of high noise levels on wildlife should be considered.

Land use guidelines have been established on the basis of studies prepared or sponsored by several federal agencies, including the Department of Housing and Urban Development, the Environmental Protection Agency, the U.S. Air Force, and state and local agencies.

Land Use Compatibility Guideline tables have been prepared by the before mentioned agencies which are useful in determining impacts on different types of land uses for different L_{dn} noise levels.

Tabular listings of Land Use Compatibility Guidelines are included for reference in Appendix C.

2.0 TRAFFIC NOISE STUDY

2.1 GENERAL TRAFFIC NOISE PARAMETERS

Traffic noise depends on three types of parameters:

1. Traffic parameters: Number of vehicles per hour, type of vehicles, and average speed of each type of vehicle. Analysis of idealized systems show that when the density of vehicles per unit length is sufficiently high, that the sideline noise for the automobiles increases linearly with traffic volume and increases approximately with the third power of the average speed. On the other hand, under the same conditions, the noise from the trucks increases linearly with volume flow but less rapidly with the increase in average speed. This is because the noise from trucks is primarily related to the engine and exhaust system which are less directly related to vehicle speed than the tire noise which is the dominant component in high speed automobile noise.

2. Roadway parameters: number of interruptions, stop signs, traffic lights; experiements have shown that interruptions can increase the L_{10} by approximately two dBA for autos and four dBA for trucks, although not increasing the L_{50} significantly. Pavement characteristics; pavement characteristics have a marked effect with a range of ten decibels between a very smooth seal coated asphalt pavement and a rough asphalt or grooved concrete pavement. Percentage gradient; gradient adjustments range from zero decibels for less than a two percent grade to a five decibel increase for a gradient of seven degrees or more. Vertical configuration, number of lanes; elevation or depression of the road from the immediate surroundings can attenuate the noise level by up to fifteen decibels.

3. Observation characteristics: the type of terrain between the observer and the roadway; whether buildings, barriers, or vegetation are present; high, solid barriers can attenuate sounds by fifteen decibels. Houses can reduce the sound by three to five decibels per rdw; distance and elevation of the receptors relative to the road and ground level; thermal and wind gradient influences on refraction of sound energy.

In order to determine the magnitude of increased traffic noise as a result of the M-X system, peak hour L_{eq} contours (recall approximately equal to L_{dn} per HUD regulations) have been calculated for affected roadways surrounding each of the prospective bases. Contours from 45 dBA (essentially no impact) to 70 dBA (serious impact on residential uses) have been calculated in 5 dBA increments.

To give results representing "worst case" conditions, a constant speed of 80 km/h, (50 mph) and a 10 percent heavy truck mixture was assumed for each traffic flow, and an excess attenuatior (in addition to the normal wave spreading loss, proportional to distance squared for point sources) of 5 dB/km for atmospheric absorption and 4 dB/km for ground effect (ref. Kurze and Beranek, Sound Propagation Outdoors, <u>Noise and Vibration Control</u>, L. Beranek, ed., pp. 171, 186). Losses due to refraction by thermal or wind gradients have not beer included.

Noise emissions from autos and heavy trucks were modeled in accordance with the FHWA Level 2 Highway Traffic Noise Prediction Model (ref. Table 2-1, p. 4 of that document), as follows:

L_{max} Auto = 38.05 log (V) - 2.20 dBA

L_{max} Truck = 24.56 log (V) + 38.54 dBA

where L is the energy average sound level at 15 m and V is the vehicle speed in km/h. At a constant speed of 80 km/h, these calculated to 70.2 and 85.3 dBA respectively. Further, the effective duration of a vehicle passage at a distance of 15 m is 1.74 seconds based on the 9 dB/km excess attenuation, resulting in sound exposure levels (SEL) of 72.6 dBA for autos and 87.7 dBA for trucks. There is no analytic expression which relates the level as a function of distance from an infinite line source when both excess attenuation and wave spreading losses are present. However, the solution is approximated within 1 dB up to 2,000 m by the expression

$$A(D)=(D/15)^{1.2} + (D/100)^3$$

where D is the closest distance from the line source in meters.

Assuming the peak hourly traffic is 15 percent of the average daily traffic (ADT) then the contours are calculated from

$$L_{eq} = SEL + 10 \log (ADT) - 10 \log (A(D)) - 43.8 \text{ dBA}$$

2.2 SECONDARY SOURCES OF NOISE

M-X construction and increased railroad activities are two potential noise sources.

2.2.1 Construction Noise

During site construction, heavy equipment will be used which could have a noise impact on the surrounding area. Construction activities will include clearing, excavation, earth moving, grading, compacting, paving, aggregate and batch plant operation, and various building work. From the nature of construction areas and the size of the sites, it has been estimated that the following equipment could be operated simultaneously within a moderately confined region:

Water Truck
Medium Bulldozer
Compactor
Heavy Bulldozer with Ripper
Scraper

Based on the maximum noise levels given by EPA (Table 2.2.1-1) for these equipment types, and assuming approximately point source wave spreading and 9 dB per km excess attenuation for atmospheric absorption and ground attenuation, sound levels of 65 dBA and 45 dBA would be experienced at 400 and 1,400 meters from the center of construction activities, respectively. Because of the remote site locations, this would not constitute a serious noise impact on any inhabited area.

Table 2.2.1-1. Typical noise levels of principal construction equipment.

NOISE LEVEL IN dBA AT 50 FEET			
Clearing:			
Bulldozer	80	Pneumatic tools	81-98
Front loader	72-84	Bulldozer	80
Dump truck	83-94	Front loader	72-84
Jack hammer	81-98	Dump truck	83-94
Crane with headache ball	75-87	Paver	86-88
Excavation and earth moving:		Grading and Compacting:	
Bulldozer	80	Grader	80-93
Backhoe	72-93	Roller	73-75
Front loader	72-84		
Dump truck	83-94	Paving:	
Jack hammer	81-98	Paver	86-88
Scraper	80-93	Truck	83-94
		Tamper	74-77
Construction:			
Crane	75-87	Landscaping and clean-up:	
Welding generator	71-82	Bulldozer	80
Concrete mixer	74-88	Backhoe	72-93
Concrete pump	81-84	Truck	83-94
Concrete vibrator	76	Front loader	72-84
Cement and dump trucks	83-94	Dump truck	83-94
Air compressor	74-87	Paver	86-88

2990

Source: U.S. Environmental Protection Agency, "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances," NTID 300.1, December 31, 1971.

Major construction activities and related noise generation at any shelter site will be of a short-term duration, generally less than one year. The effects of shelter construction noise on the animals in the area should be minor. However, at this time the impact on animal life has not been determined.

There will also be noise generated during construction as a result of traffic along the DTN of equipment and personnel. A typical traffic volume during the peak construction period is 5,000 vehicles per day (30 percent heavy trucks; 70 percent automobiles) assuming cast-in-place construction methods with irrigation for revegetation being applied around protective structures only, and includes assembly and check-out personnel. The contours are presented in Table 2.2.1-2.

Because of the remote locations and sparse population densities, it is expected that construction noise generation at all locations will have minimal impact upon the people in the area.

2.2.2 Railroad Noise

During project construction, transportation of some materials to the sites will be by rail, resulting in increased noise exposure along the railroad right-of-way.

Railroad noise can be divided into three components:

1. Transient, predominantly low frequency sound radiated by the locomotive engines.
2. Continuous, broad band noise radiated primarily by the wheel/track interaction on the cars.
3. Transient noise from the crossing warning horn.

During peak construction, approximately 160 cars or 440 car trains, are estimated to arrive weekly at the construction depots. Since there are two construction areas, only two trains would impact a single area during a week period. The increase in noise level as a result of this infrequent schedule is expected to be minor.

2.3 TRAFFIC NOISE LEVELS IN THE VICINITY OF THE OPERATING BASES

In the vicinity of each potential base site, traffic volume maps were developed (see Technical Report on Traffic). The traffic maps are presented in Figure 2.3-1 through 2.3-14 showing both existing or recent traffic counts and projections for the year 1992 with and without the M-X system.

Sound level contours, in meters from the centerline of the road, were calculated for the above cases using sound levels from 45 dBA to 70 dBA in five dBA increments. Results are presented in Table 2.3-1. In the last column, the L_{eq} at fifteen meters is given for each case.

COMPARISON OF BASE SITES. The following summarizes the increased noise exposures in the areas of the six prospective M-X sites with regard to the 65 dBA criterion. This level was chosen because, if levels in residential areas are caused to

Table 2.2.1-2. Typical construction traffic noise from DTC during peak construction period.

5,000 AVERAGE DAILY TRIPS 30% HEAVY TRUCKS	
L_{eq}	DISTANCE (METERS)
45	1,031
50	672
55	414
60	234
65	113
70	47
76	15

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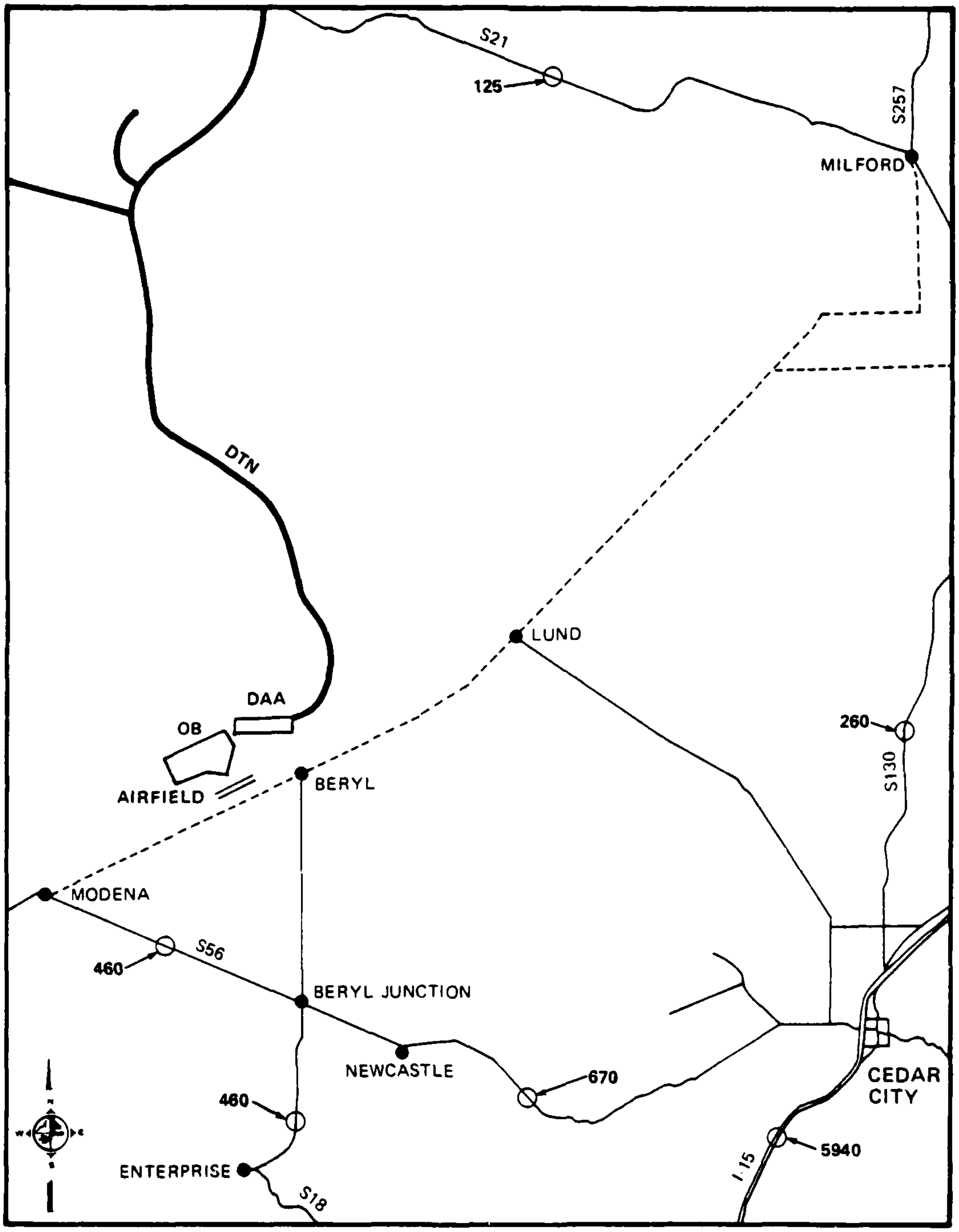


SCHEMATIC. NOT TO SCALE 2184-A

LEGEND 000 - 1978 TRAFFIC VOLUMES; BERYL, UTAH

SOURCE: UTAH DEPARTMENT OF TRANSPORTATION

Figure 2.3-1. 1978 traffic volumes, Beryl, Utah (not to scale).

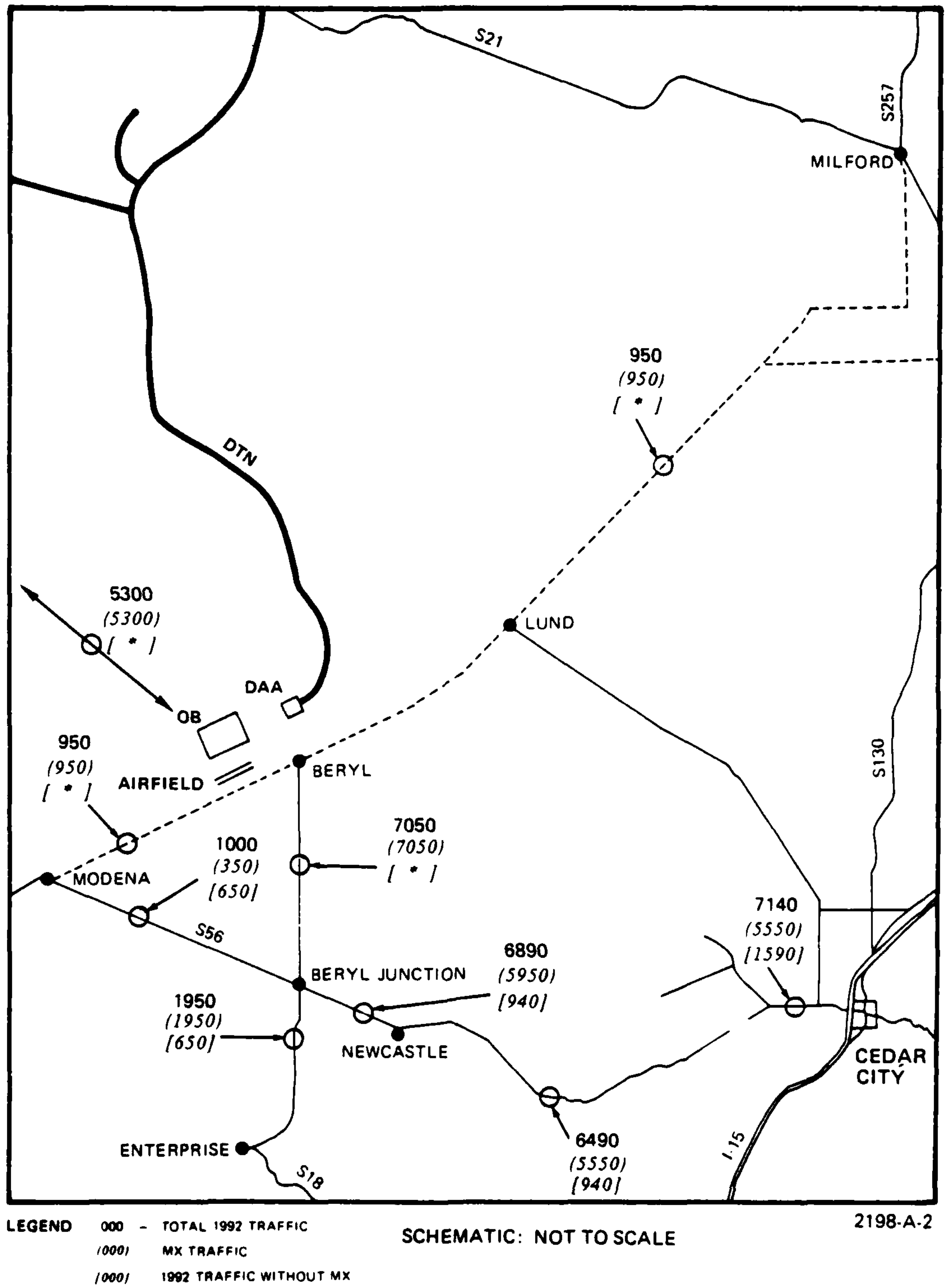
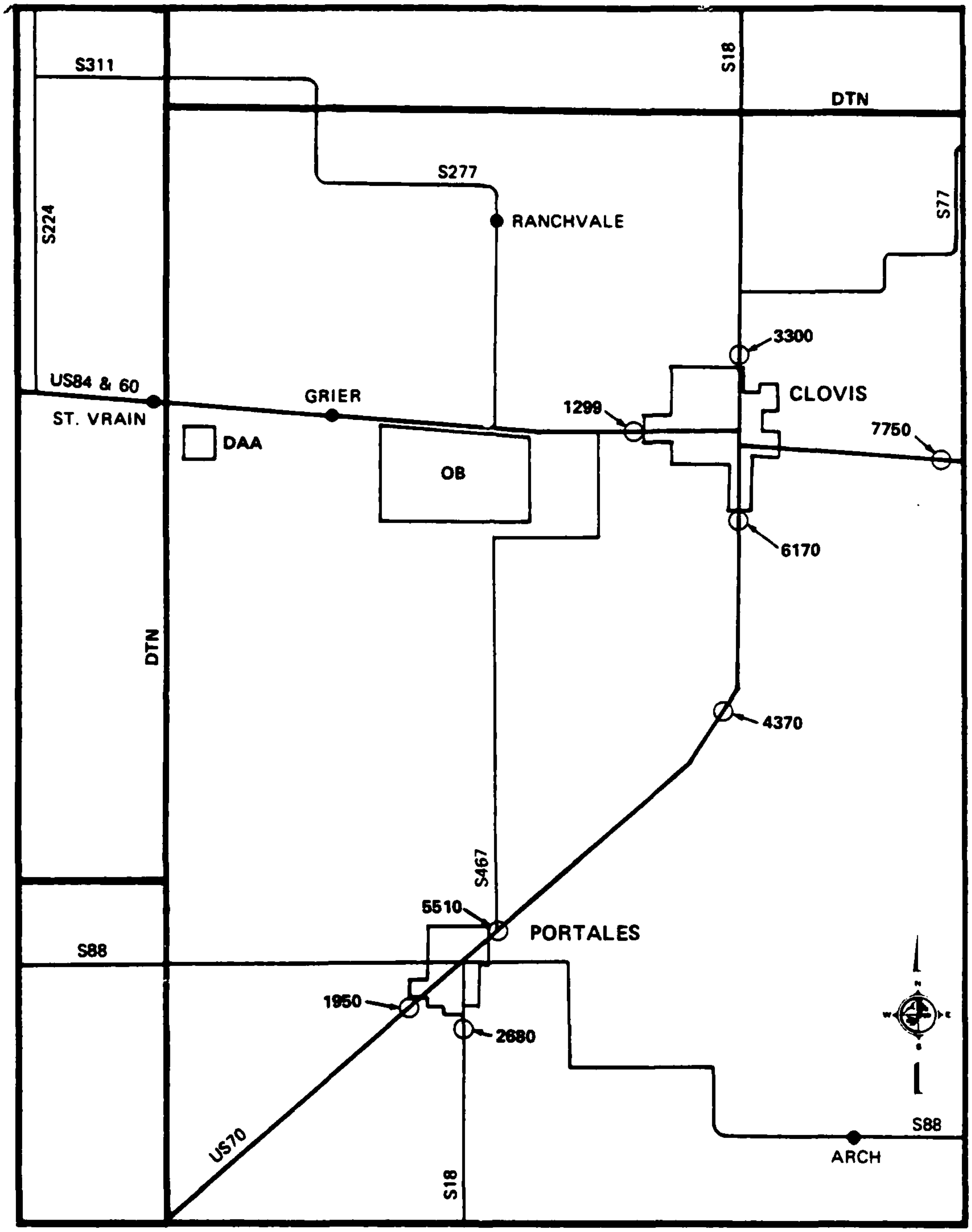


Figure 2.3-2. 1992 traffic volumes, Beryl, Utah (not to scale).



LEGEND 000 - 1978 TRAFFIC VOLUMES; CLOVIS, NEW MEXICO

2181-A

SOURCE: NEW MEXICO STATE HIGHWAY DEPARTMENT

SCHEMATIC: NOT TO SCALE

Figure 2.3-3. 1978 traffic volumes, Clovis, New Mexico (not to scale).

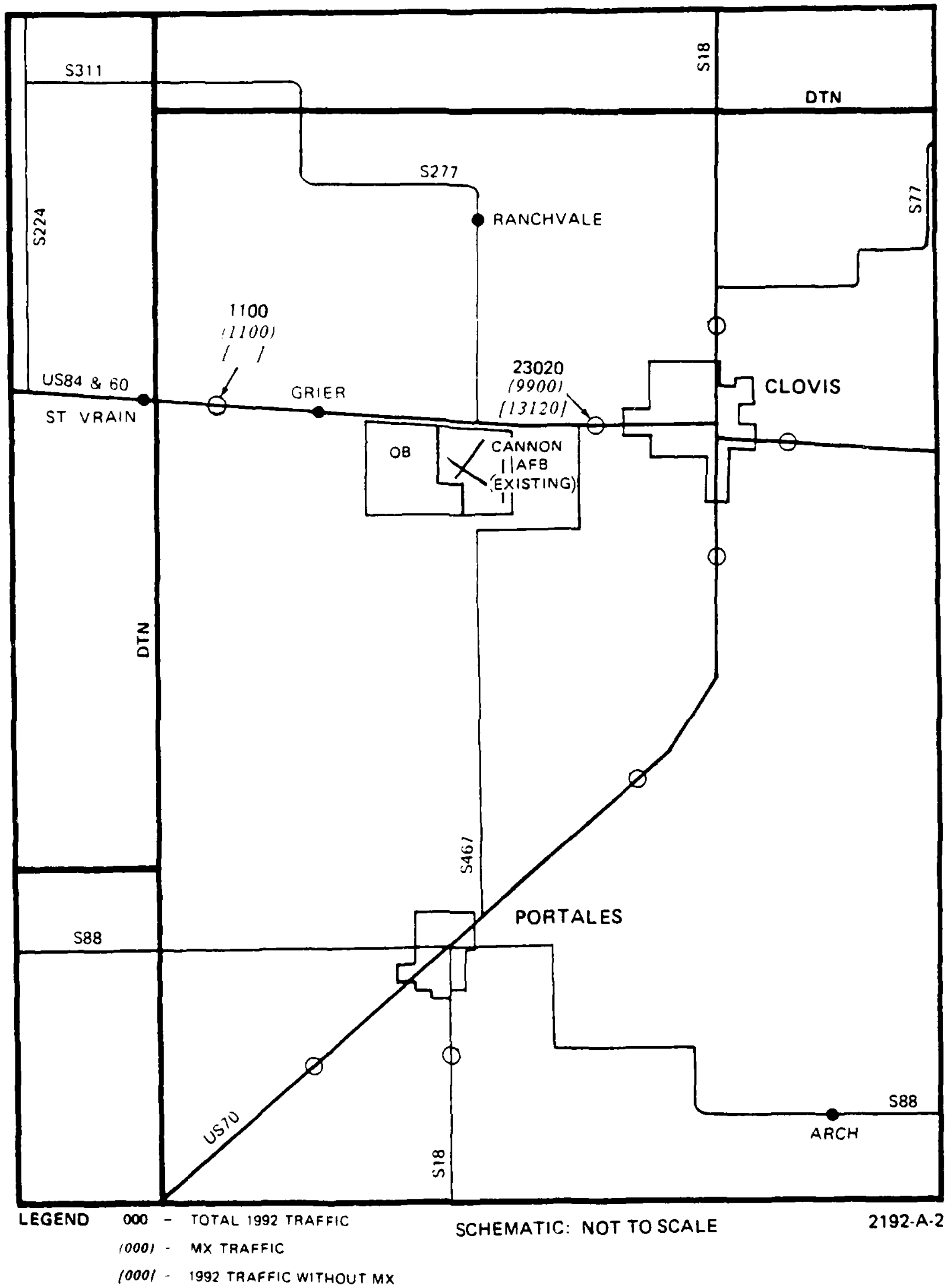
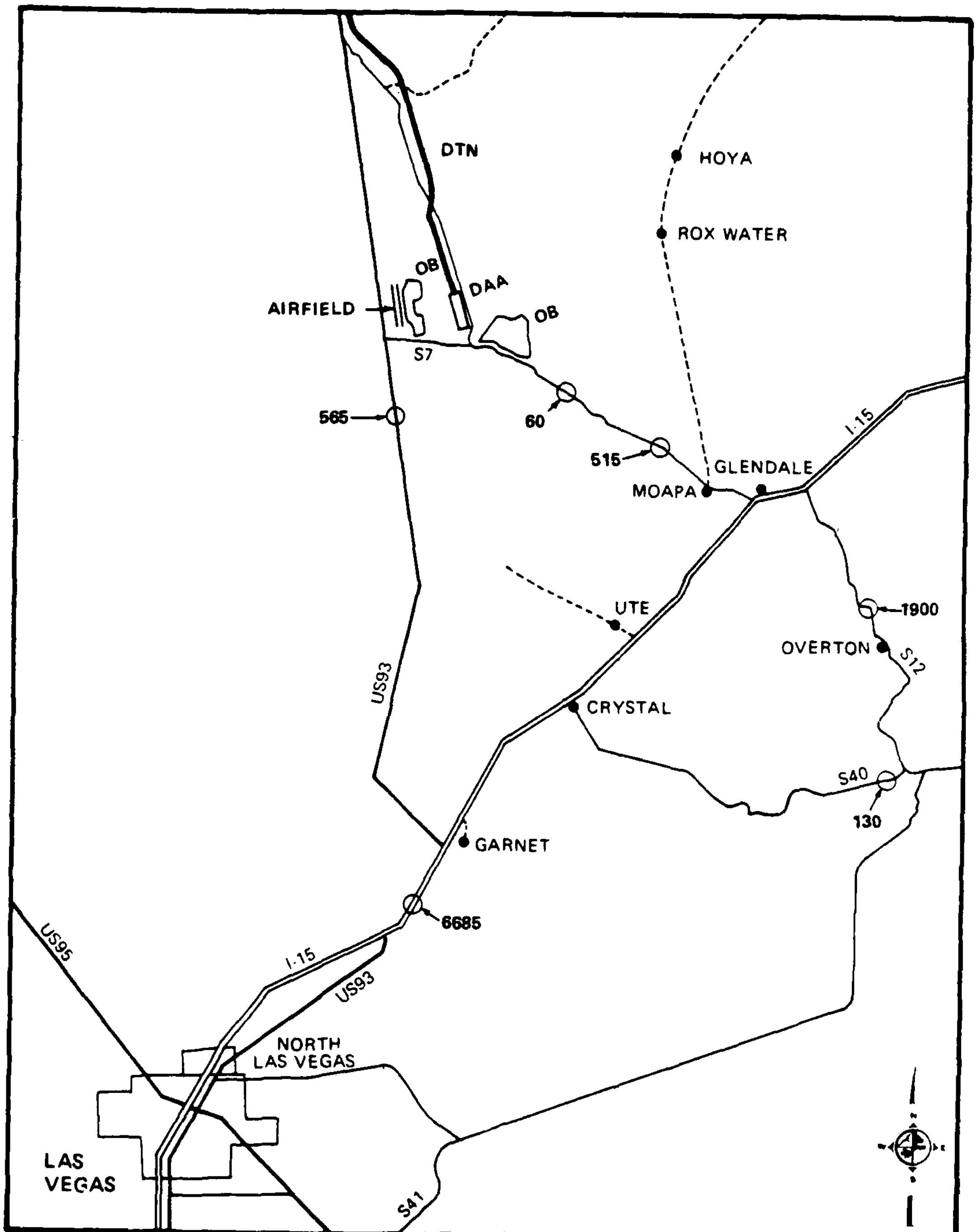


Figure 2.3-4. 1992 traffic volumes, Clovis, New Mexico (not to scale).



LEGEND 000 - 1979 TRAFFIC VOLUMES; COYOTE SPRINGS, NEVADA

2183-A

SCHEMATIC: NOT TO SCALE

SOURCE: NEVADA DEPARTMENT OF TRANSPORTATION

Figure 2.3-5. 1979 traffic volumes, Coyote Spring Valley, Nevada (not to scale).

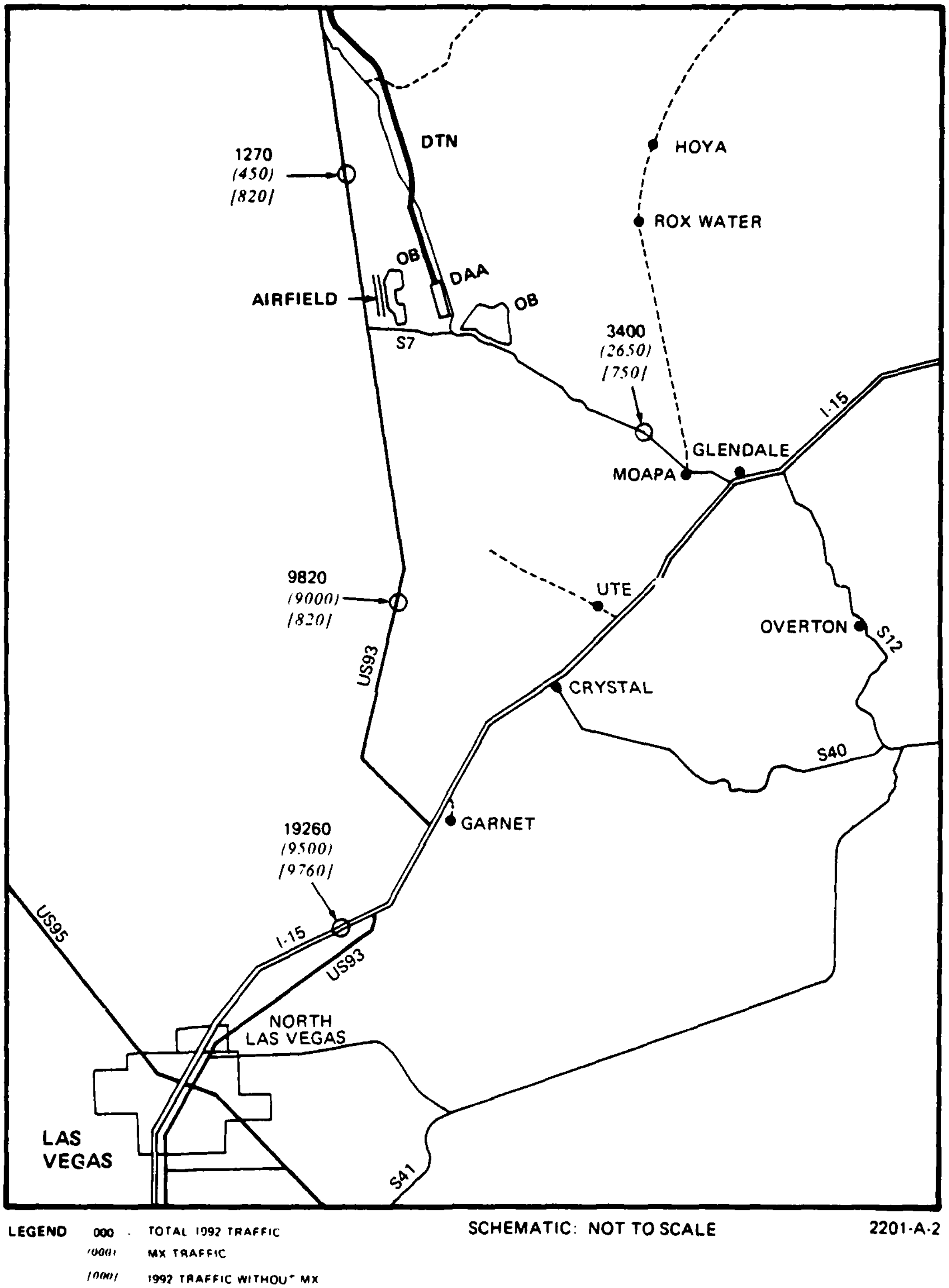
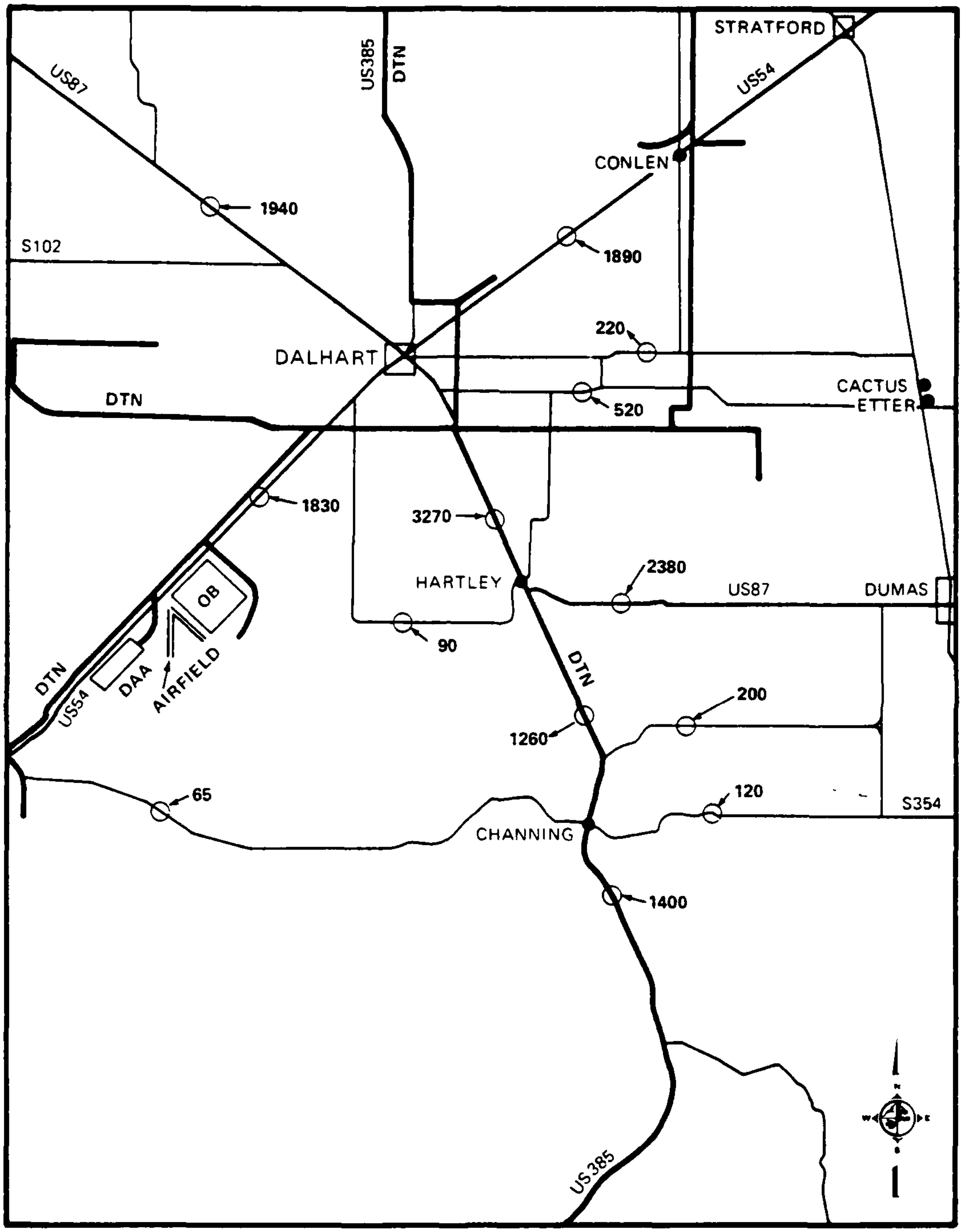


Figure 2.3-6. 1992 traffic volumes, Coyote Spring Valley, Nevada (not to scale).



LEGEND 000 - 1975 TRAFFIC VOLUMES; DALHART, TEXAS

2180-A

SOURCE: TEXAS STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

SCHEMATIC: NOT TO SCALE

Figure 2.3-7. 1975 traffic volumes, Dalhart, Texas (not to scale).

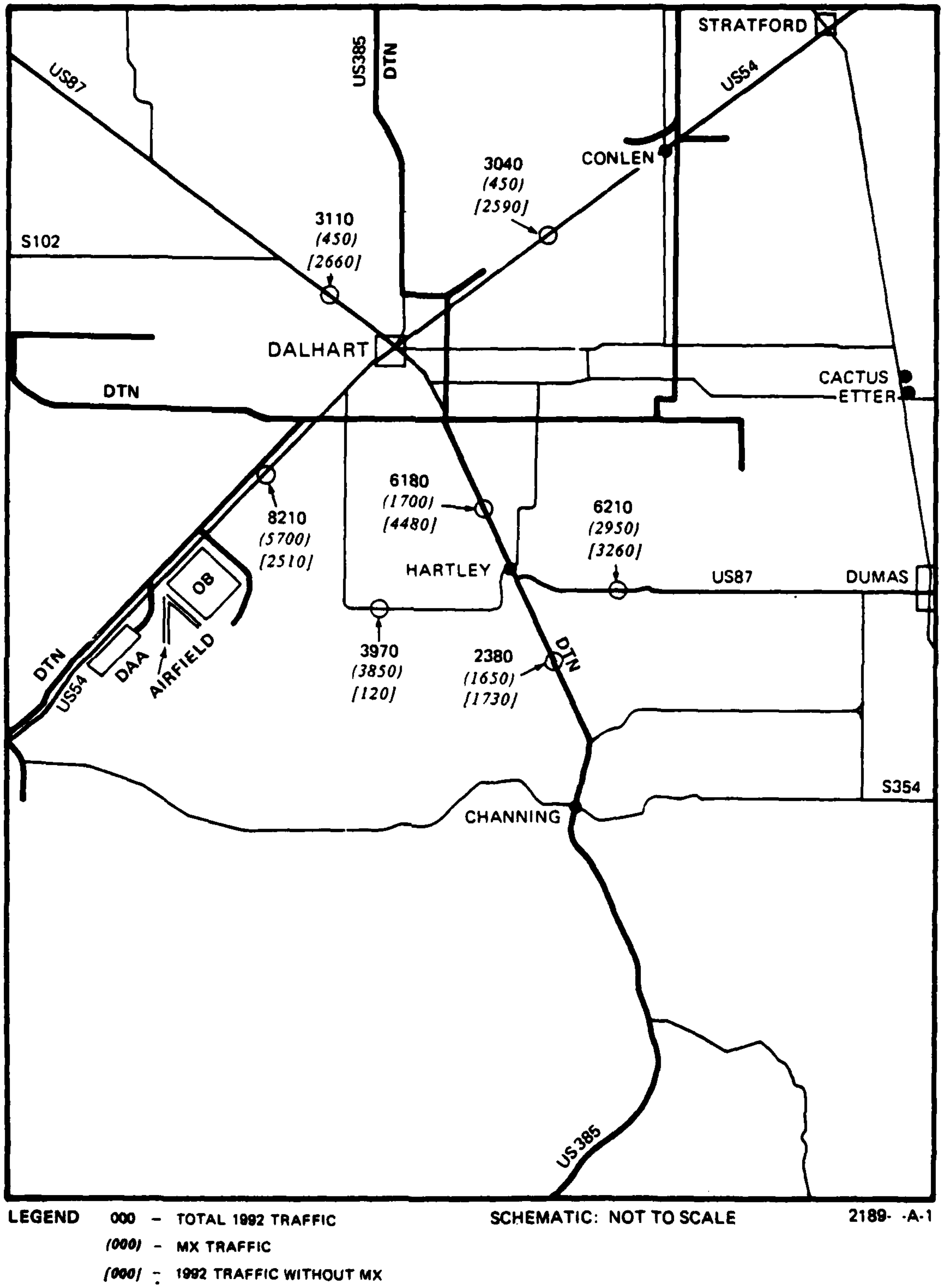
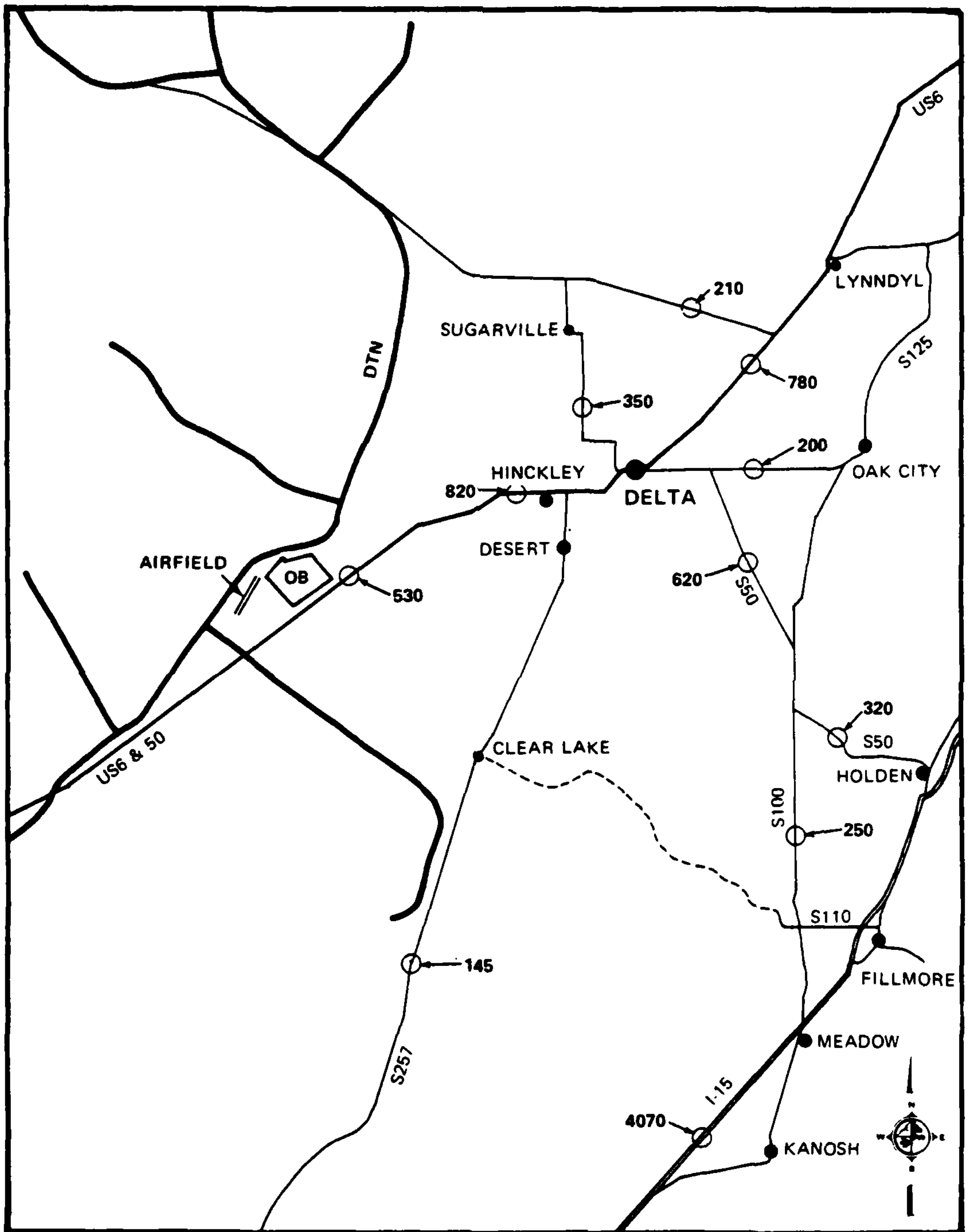


Figure 2.3-8. 1992 traffic volumes, Dalhart, Texas (not to scale).

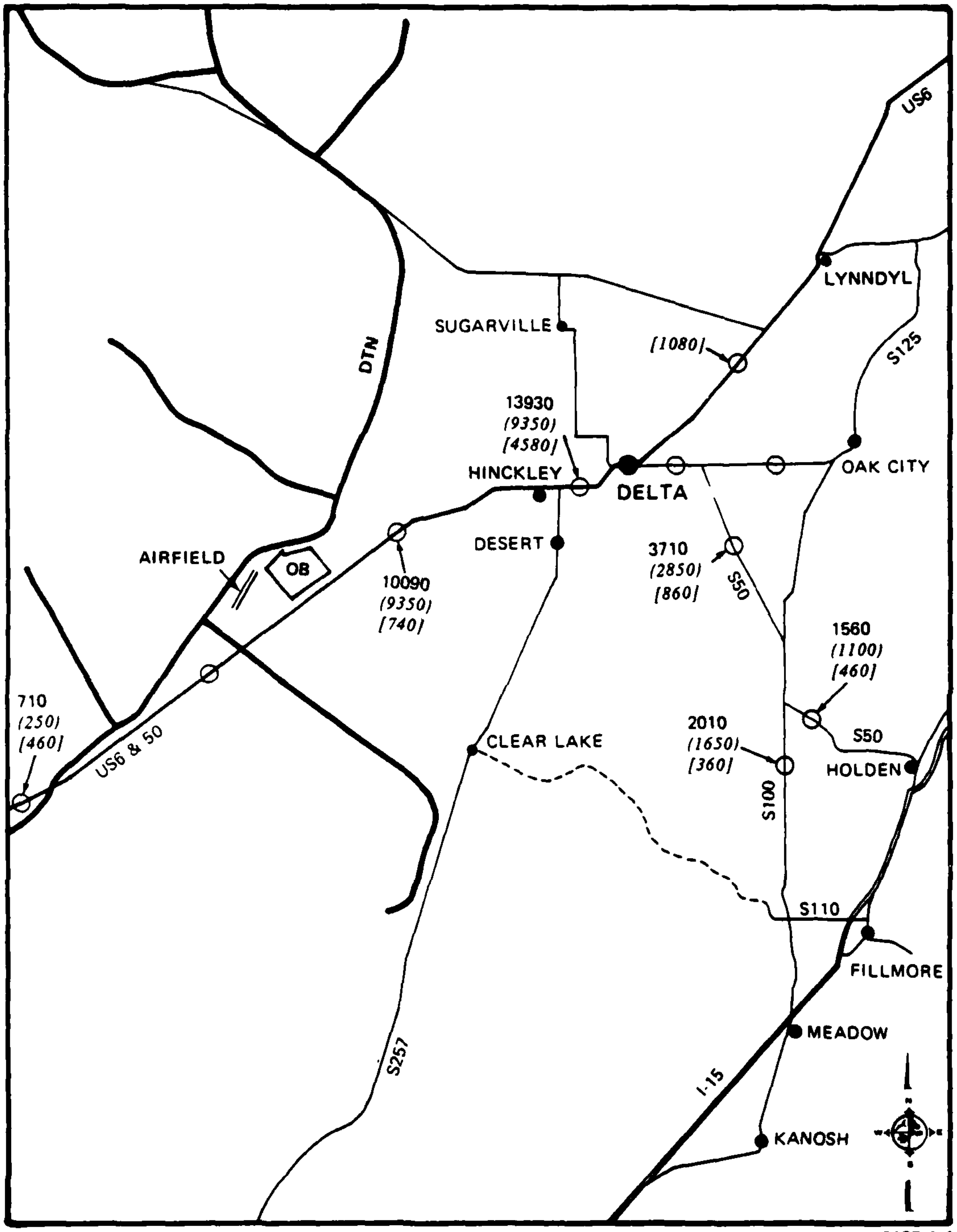


LEGEND 000 - 1978 TRAFFIC VOLUMES; DELTA, UTAH

SCHEMATIC : NOT TO SCALE 2182-A

SOURCE: UTAH DEPARTMENT OF TRANSPORTATION

Figure 2.3-9. 1978 traffic volumes, Delta, Utah (not to scale).



LEGEND 000 - TOTAL 1992 TRAFFIC
(000) - MX TRAFFIC
[000] - 1992 TRAFFIC WITHOUT MX

2195-A-1

SCHEMATIC: NOT TO SCALE

Figure 2.3-10. 1992 traffic volumes, Delta, Utah (not to scale).

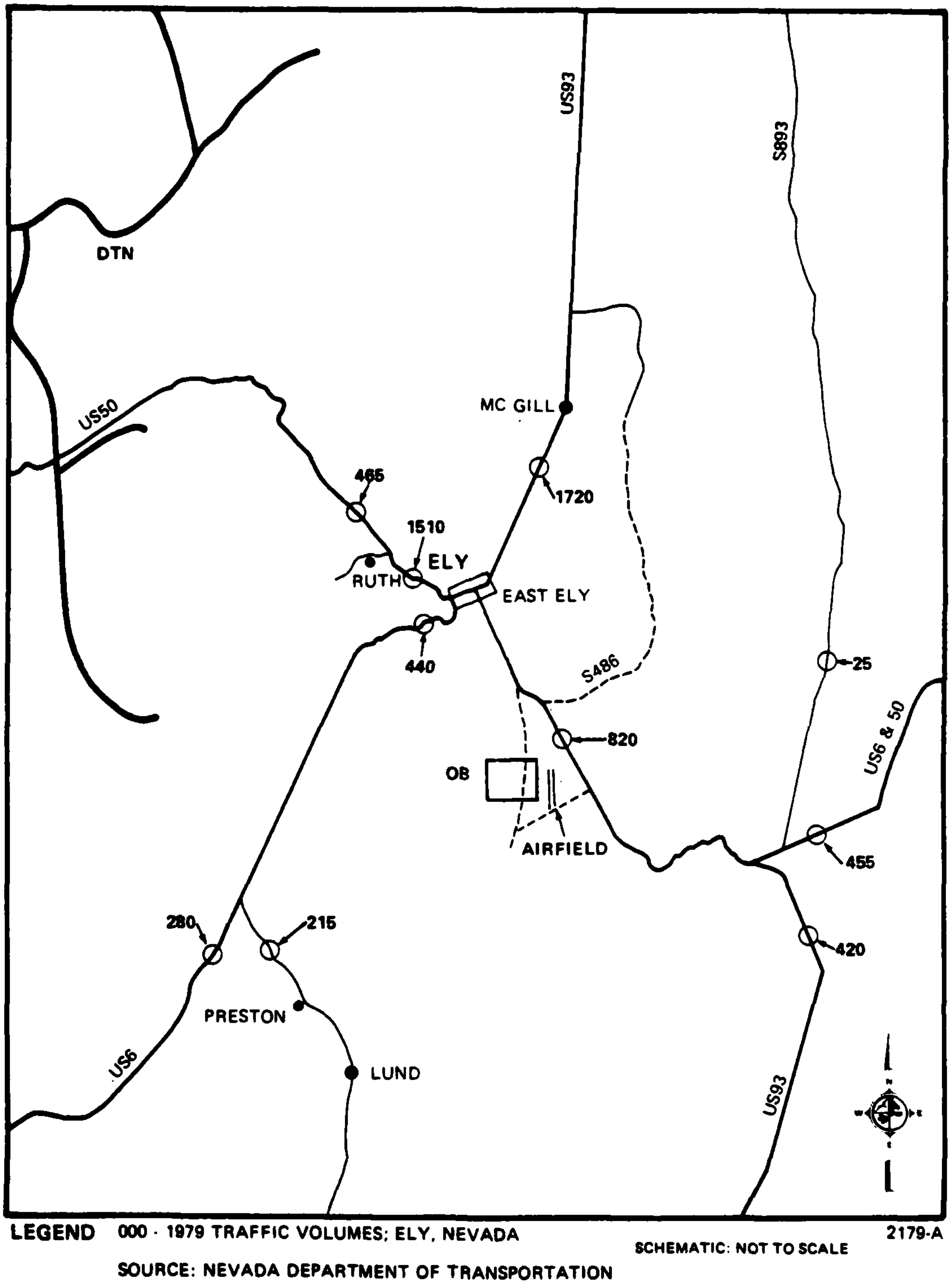


Figure 2.3-11. 1979 traffic volumes, Ely, Nevada (not to scale).

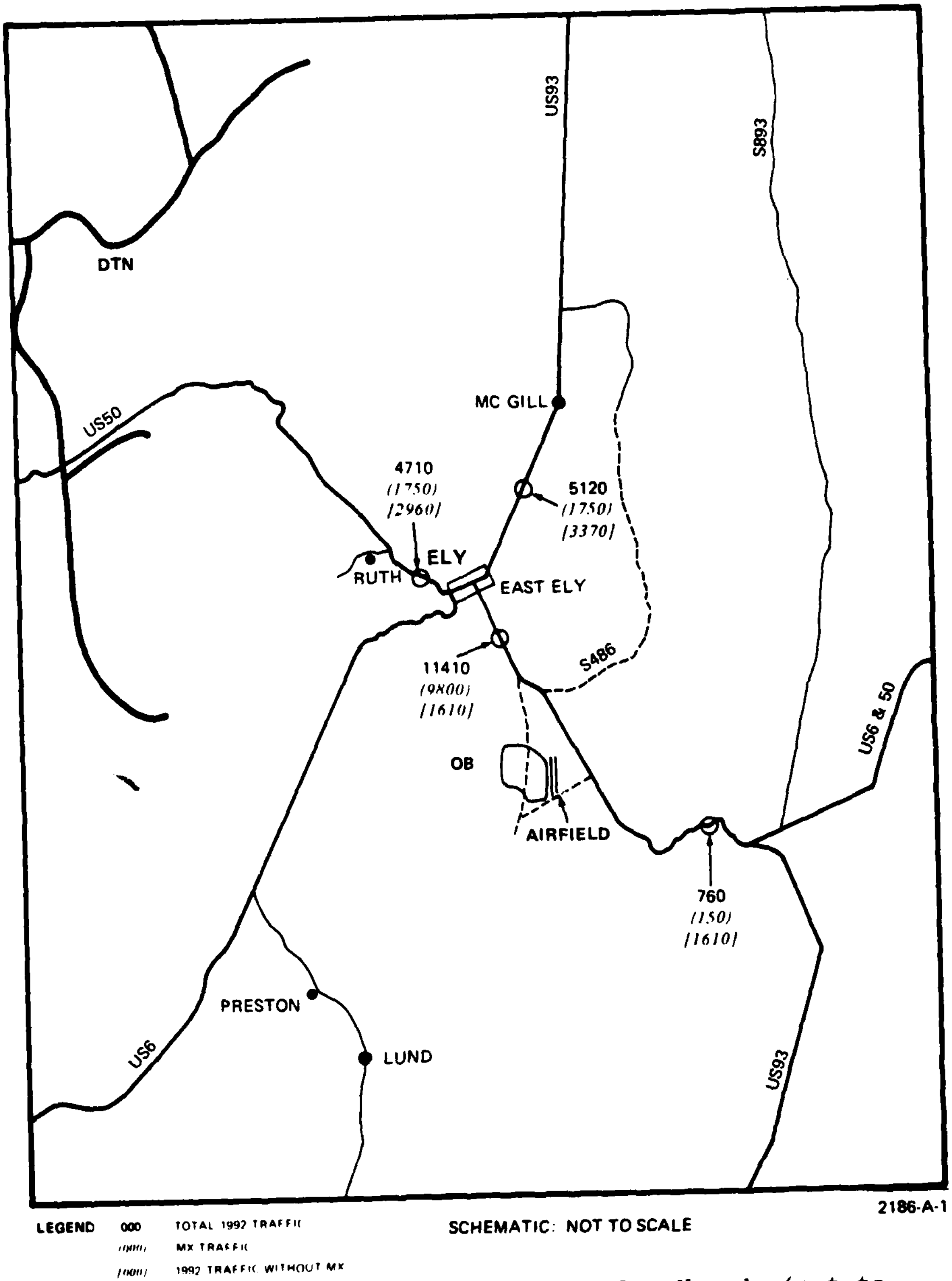


Figure 2.3-12. 1992 traffic volumes, Ely, Nevada (not to scale).

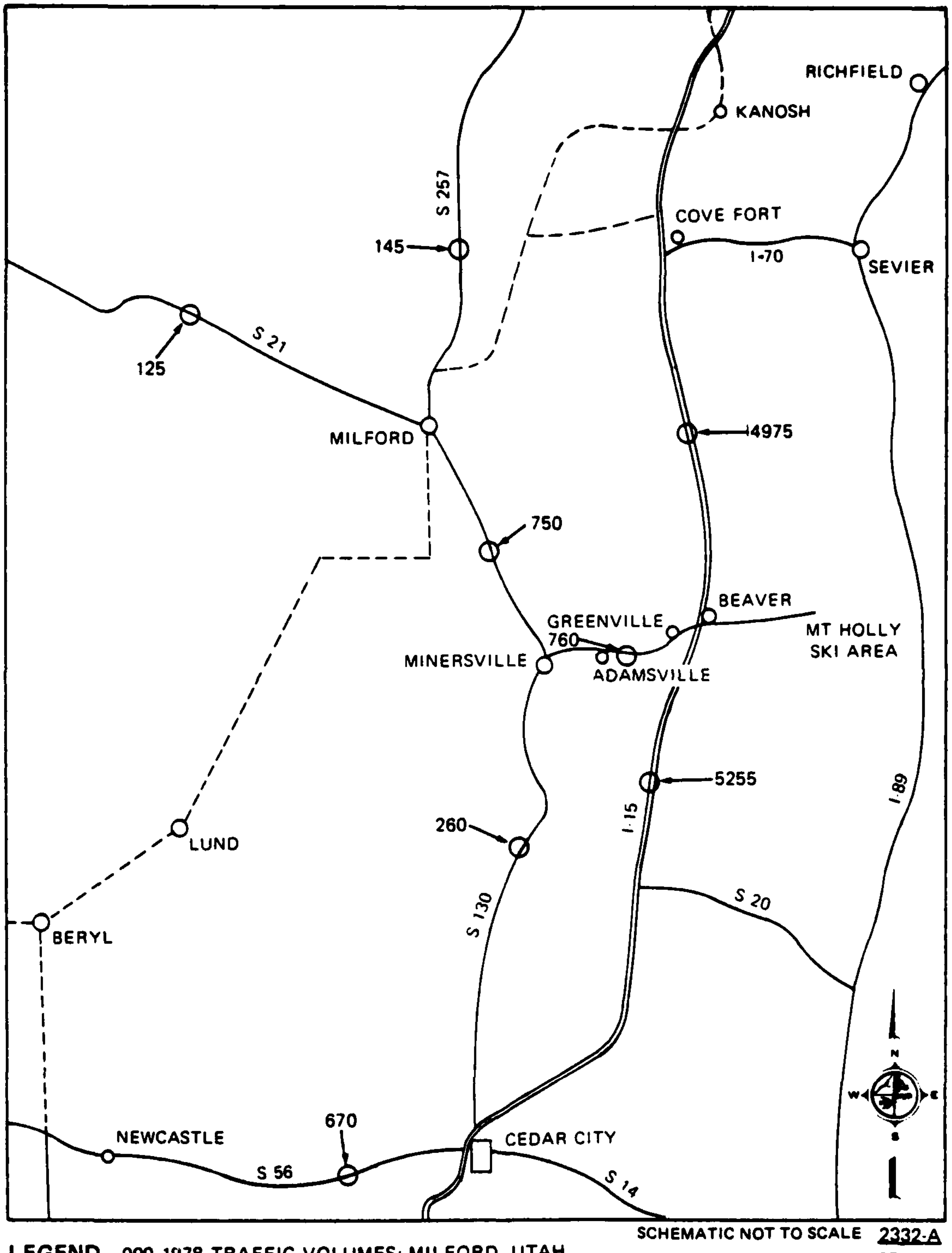


Figure 2.3-13. 1978 traffic volumes, Milford, Utah (not to scale).

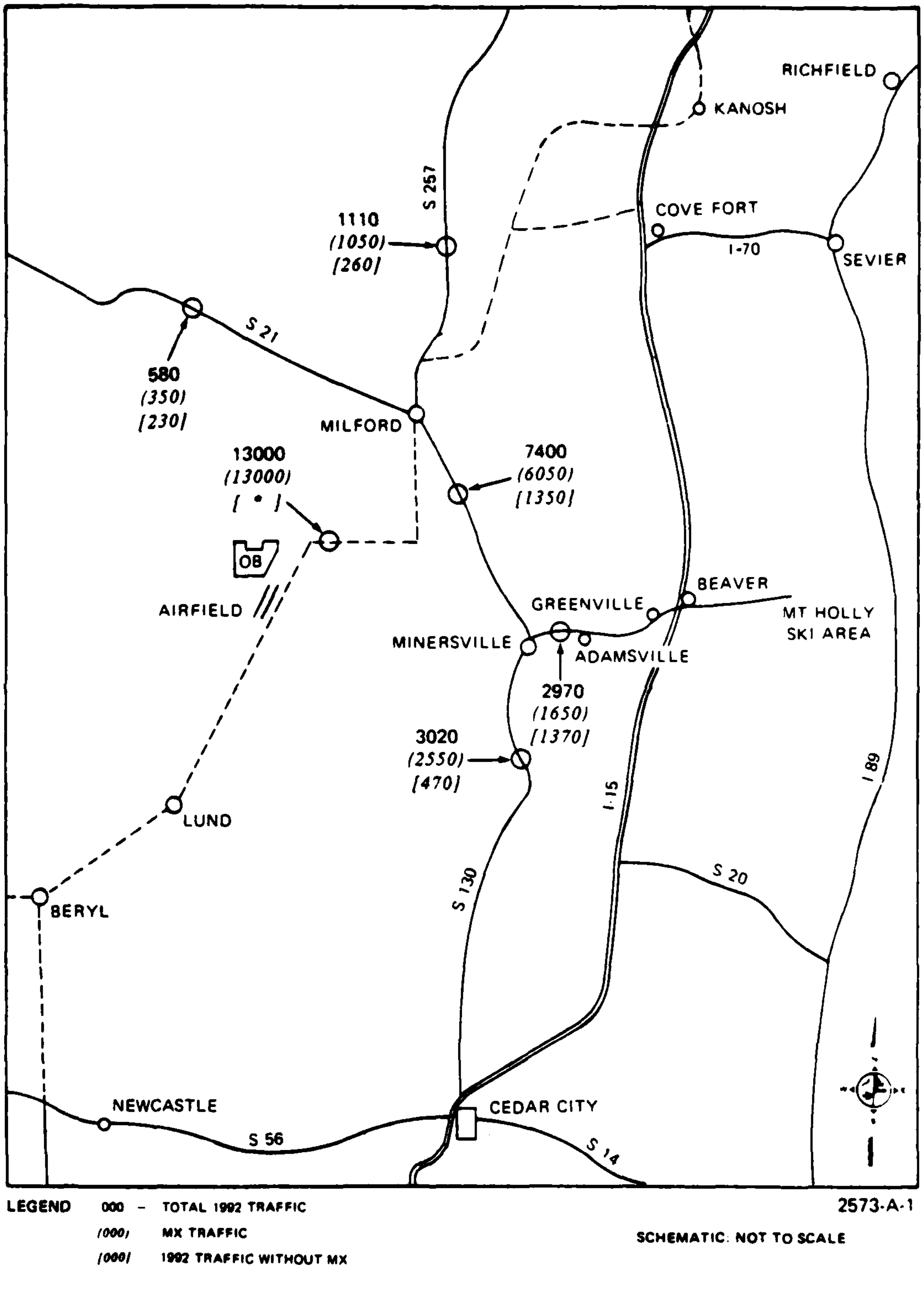


Figure 2.3-14. 1992 traffic volumes, Milford, Utah (not to scale).

Table 2.3-1. Traffic noise contours. (Page 1 of 2)

LOCATION	AVERAGE DAILY TRAFFIC	DISTANCE TO LEQ CONTOURS IN METERS						LEQ IN dBA AT 15 METER
		45 dBA	50 dBA	55 dBA	60 dBA	65 dBA	70 dBA	
Beryl, Utah								
State 56, West of Cedar City	1,130[1]	394	219	103	42	17	6	65
	1,590[2]	460	265	132	55	22	9	67
	3,140[3]	609	372	203	93	38	15	70
State 56, Beryl Junction to Newcastle	460	252	124	52	20	8	3	62
	920	359	194	88	37	17	6	65
	6,890	825	525	312	162	72	28	73
State 18, Beryl Junction to Enterprise	460	252	124	52	20	8	3	62
	650	303	156	68	27	11	4	63
	1,950	501	295	151	65	26	10	68
State 56, West of Modena	290	194	88	36	14	6	2	60
	650	303	156	68	27	11	4	63
	1,000	373	204	94	39	15	6	65
Clovis, New Mexico								
U.S. 84, West of Clovis	12,990	1,040	677	420	237	114	47	76
	13,120	1,044	680	422	238	115	47	76
	23,020	1,276	842	537	321	167	74	79
Coyote Spring, Nevada								
I-15, Las Vegas to Garnet	6,685	816	519	307	159	69	28	73
	9,760	938	605	369	201	93	38	75
	19,260	1,198	788	498	293	149	65	78
U.S. 93	515	268	134	57	22	9	3	62
	820	340	181	81	33	12	5	64
	9,800	937	606	370	201	93	38	75
Dalhart, Texas								
Base to Hartley, County Road	90	87	35	14	6	2	0	54
	120	107	44	17	6	3	1	56
	3,970	668	414	233	111	46	18	71
U.S. 54, Base to Dalhart	1,830	488	285	145	62	25	9	68
	2,510	566	340	181	82	33	13	69
	8,210	880	564	340	181	81	33	74
U.S. 87, Dumas	2,880	545	326	171	76	30	11	69
	3,260	619	378	208	96	39	15	70
	6,210	794	503	296	151	66	26	73
Delta, Utah								
U.S. 6 and U.S. 50, Northwest of Base	530	272	136	58	22	9	3	62
	740	322	170	75	30	11	4	64
	10,090	947	612	374	204	95	39	75
U.S. 50, West of Delta	3,300	622	381	209	97	40	15	70
	4,580	706	441	252	123	52	20	72
	13,930	1,067	696	433	247	120	50	76
U.S. 50 East of Delta	200	153	66	26	10	4	1	58
	1,080	386	214	100	41	16	6	65
	2,980	597	363	197	91	36	14	70
Ely, Nevada								
U.S. 93, State 486 Junction to Ely	320	340	181	81	33	13	5	64
	1,610	462	266	132	56	22	9	67
	11,410	993	644	397	220	104	43	76
U.S. 93, North of Ely	1,720	475	276	139	59	23	9	67
	3,370	627	284	211	99	40	16	70
	5,120	727	463	267	133	56	22	72
U.S. 50, Ely to Ruth	1,510	449	258	126	53	21	8	67
	2,960	595	362	196	90	36	14	70
	4,710	714	446	255	126	52	21	72

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Table 2.3-1. Traffic noise contours. (Page 2 of 2)

LOCATION	AVERAGE DAILY TRAFFIC	DISTANCE TO LEQ CONTOURS IN METERS						LEQ IN dBA AT 15 METER
		45 dBA	50 dBA	55 dBA	60 dBA	65 dBA	70 dBA	
Milford, Utah								
Milford to Lund, County Road	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—
	9,450	927	597	363	197	91	36	75
Milford to Minersville	750	325	171	76	30	11	4	64
	1,350	427	242	117	49	19	7	66
	6,450	826	526	312	162	72	28	73
Minersville to Cedar City	260	181	82	33	13	5	2	60
	470	255	126	52	21	8	3	62
	2,770	580	351	188	85	34	14	69
Minersville to Greensville	760	327	173	77	30	12	5	64
	1,370	430	244	118	50	20	7	66
	2,970	596	362	196	90	36	14	70

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[1]Existing or most recent traffic count.

[2]1992 Traffic volumes without M-X.

[3]1992 traffic volumes with M-X.

exceed 60 dBA, an accelerated possibility of negative reaction is to be expected, and above 65 dBA the levels will exceed HUD and some local noise criteria.

Beryl, Utah:

Western Cedar City - widening of 65 dBA contours from 22 to 38 m with respect to the road centerline of State 56; could impact residences bordering the highway.

Newcastle - widening of 65 dBA contours from 14 to 72 m; would have a noticeable impact on noise sensitive uses bordering State 56.

Beryl Junction - Widening of 65 dBA contours from 11 to 26 m at the south end of town and to 72 m at the east side of town. Would impact residences and other noise sensitive uses in these areas. Negligible impact at the west side of town.

Modena - Small impact on residences bordering State 56 within 15 meters.

Clovis, New Mexico:

Western Clovis - High traffic noise levels along US 84 with or without M-X system. M-X traffic increases exposure levels approximately 2 dBA.

Southern, Eastern and Northern Clovis - negligible impact.

Portales - negligible impact.

Coyote Spring, Nevada:

North Las Vegas - widening of 65 dBA contours from 93 to 149 m along I-15. Moderate 4 dBA impact on residential or other noise sensitive uses near I-15.

US 93 - approximately 11 dBA increase in noise levels, with 65 dBA contours at 93 m. Negligible impact due to apparent lack of habitation.

Dalhart, Texas:

Conlen - negligible impact.

Southwestern Dalhart - widening of 65 dBA contour from 33 to 81 m along US 54, with strong (5 dB) impact on residential and other noise sensitive uses bordering US 54.

Other Dalhart - negligible (1 dB or less) impact.

Hartley - establishment of 65 dBA contour at 46 m from country road at west side of town, an increase of nearly 15 dB, with high likelihood of negative community reaction. Moderate impact on southern and eastern Hartley. Negligible impact on northern Hartley.

Dumas - widening of 65 dBA contours from 39 to 66 m at west end of town, with moderate impact (3 dB) on residences and other noise sensitive uses bordering US 87.

Delta, Utah:

Hickley - widening of 65 dBA contours from 11 to 95 m, with impact exceeding 70 dBA expected for uses bordering US 6 and 50. Serious impact (11 dBA increase) on residences near the highway.

Western Delta - widening of 65 dBA contour from 52 to 120 m. Four dBA increase in impact.

Eastern Delta - widening of 65 dBA contour from 16 to 36 m. Strong impact on noise sensitive uses immediately adjacent to the highway.

Ely, Nevada:

Western Ely - widening of 65 dBA contour from 36 to 52 m along US 50, with moderate noise impact on uses immediately adjacent to the highway.

Southeastern Ely - 9 dB noise increase with widening of 65 dBA contours from 22 to 104 m. Strong noise impact on residences (fewer than 10 units) adjacent to the highway.

Milford, Nevada:

To Lund - currently there is little traffic on this road. A significant impact would occur with the projected operating base traffic. The 65 dBA contour would be at 91 m.

To Minersville - widening of 65 dBA contour from 19 to 72 m. Significant increase in noise impact (7 dBA) with M-X project.

To Cedar City - widening of 65 dBA contour from 8 to 34 m. Strong impact on residences near highway.

To Greensville - widening of 65 dBA contour from 20 to 36 m. Strong impact on residences near highway.

The above synopsis of noise impacts on the areas surrounding each of the prospective M-X base sites suggests a moderate to high noise increase along most roadways. In many cases, this is a consequence of the extremely low existing traffic volumes, and the result of the added vehicle traffic would be a transformation of the areas from "quiet rural" to "average suburban residential" character. Additionally, although the impacts have been stated in terms of widened 65 dBA contours and noise level increases, the true impact depends upon noise levels and their effect on the local population. Because of the sparse level of habitation in most areas, a low overall noise impact is expected.

Finally, it must be emphasized that the noise contours as calculated for this report are conservative, since only one component of atmospheric attenuation was included, speeds were assumed constant at 80 km/h, whereas they would likely be reduced in populated areas, and all trucks were considered as "heavy".

2.4 TRAFFIC NOISE LEVELS IN THE DDA DURING OPERATIONS

Once construction is completed in the dedicated deployment area, traffic will be greatly reduced on the DTN and cluster roads. Table 2.4-1 shows the projected annual trips for the entire deployment area. Assuming that about a quarter of the trips are generated from each of the four ASCs, average daily trips on the DTN would be less than 100 per day, excluding fuel deliveries. Cluster road levels would be even less. At this level of activity, the noise impact of operations would be minor.

2.5 TRAFFIC NOISE MITIGATION MEASURES

There are several methods for mitigating traffic noises resulting from the M-X project. It is possible that some or all of these measures may be undertaken in certain sensitive areas.

The need for and extent of mitigation methods can only be determined after Tier 2 field studies which would gather detailed information on topography, type and number of structures, vehicle mixes and speeds, and sound level measurements. Mitigation measures may also require further study. For instance, diverting truck traffic and building by-pass roads may direct development. Related considerations to be addressed in Tier 2 studies include funding of construction and maintenance of by-pass roads or sound barriers.

1. Reduction of noise levels by alternate highway design. By elevating or depressing the existing or new highways, it may be possible to obtain significant reductions in the sound level.

2. Reduction of noise levels by traffic control. It may be possible to divert truck traffic in certain areas around populated areas.

3. Reduction at receptor locations. Structures may be shielded from external noise sources by acoustical treatment including closure or sealing off of window areas, by double paning, replacement with glass block or brick, etc.

4. Reduction by path interference. Barrier walls, earth berms, or combinations thereof, are devices that can be used to break the sound path between the source and the receptor. A reduction of 10 dBA or more is possible by such a barrier. The barrier must have reasonable mass, be impervious to air flow, and block the direct line between the source and the receptor.

Table 2.4-1. Operation and support vehicle traffic.[1]

VEHICLE TYPE	ORIGIN	ROUTE DESTINATION	TYPE OF ROAD UTILIZED	ANNUAL TRIPS[2]	COMMENTS
Special Transport Vehicle	OB/DAA	CMF	DTN	160	Requires 2 escort vehicles
Special Transporter/ Mobile Launcher	PS/CMF	PS/CMF	Cluster Roads	1,200	
Bulldozer (Tractor and Low Bed)	ASC	Cluster barrier	DTN and/or existing roads	140-160	Barrier removal
Cluster Lid Vehicles (3) Overburden Removal Crane Front Loader (Tractor/ Low Bed)	ASC	Cluster	DTN and/or existing roads	450	SAL shelter lid removal and replacement
Crew Bus (Maintenance)	ASC	Cluster	DTN and/or existing roads	1,300-2,800	Transport field maintenance crew to job
Crew Bus (40-man)	OB/DAA	ASC	DTN and/or existing roads	2,550-3,850	Five-day duty cycle at ASC
Security Crew Van (2-man)	ASC	Cluster	DTN and/or existing roads	37,230	Roving patrol replaced every 8 hours
Roving Patrol Vehicle	ASC	Cluster	DTN and/or existing roads	10,400	Patrol vehicles returned to ASC weekly for maintenance
Gasoline Tank Truck	OB/ASC	ASC/SAF	DTN and/or existing roads	TBD	Consumption primarily determined by roving patrol requirement

1751

[1]Excludes road maintenance and administrative vehicles.

[2]Total M-X basing area round trips.

3.0 AIRPORT NOISE STUDY

3.1 GENERAL AIRPORT NOISE PARAMETERS

Airport noise generation is determined by many factors. Some of the principal ones are listed below.

1. The type of aircraft - number and type of engines
2. Direction of takeoffs and landings
3. Number of takeoffs and landings, as well as overflights
4. Loading of the aircraft
5. Meteorological conditions, including winds, temperature, and altitude
6. The time of day and distribution of runway use

3.2 AIRPORT OPERATION

The operating base airfields are proposed to have certain quantities and types of aircraft permanently assigned to them and be visited by certain quantities and types of transient aircraft regardless of the base selection. The projected quantities and types of permanently assigned aircraft for each airfield depend upon whether contiguous or split basing of the missile shelters is selected, as shown in Table 3.2-1. The types, function and frequency of the aircraft expected to use each airfield is dependent upon whether contiguous or split basing of the missile shelters is selected as shown in Table 3.2-2.

Table 3.2-3 is a summation of the projected and expected aircraft types, daily takeoffs and landings on a daytime or nighttime basis. Daytime operations are from the hours of 0700 to 2200. Nighttime operations are from 2200 to 0700. The daytime and nighttime frequency of aircraft operations along with aircraft type is used in the computer program to generate the L_{dn} noise contours around each of the airports.

3.3 NOISE CONTOUR MODEL

The FAA Integrated Noise Model (INM), program No. 3600-16.0.003, provides a conceptually simple method for characterizing aircraft noise near airfields. It includes a determination of the the day-night average sound level, L_{dn}, at a number of points surrounding a particular airfield.

Noise data for common aircraft types are included in the program. Standard aircraft operational procedures, specifically takeoffs utilizing ATA procedures and landings with maximum certificated flaps settings, have been assigned operational codes.

The FAA Integrated Noise Model Users Guide, FAA Report No. FAA-EQ-76-2, dated March, 1976, U.S. Department of Commerce Bulletin No. AD-A035-062, dated March 1976, was used as a reference and guide for using the computer noise model.

Table 3.2-1. Permanently assigned aircraft proposed for each operating base (airfield) for alternatives of contiguous and split basing of missile shelters.

TYPE OF AIRCRAFT	CONTIGUOUS BASING	SPLIT BASING	FREQUENCY
E-3A/707	5	10	103/month
CH-53E (Helicopter)	8	8	8/day

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Table 3.2-2. Transient aircraft type, function and frequency exp^cted for each, operating base (airfield) for alternatives of contiguous and split basing of missile shelters.

TYPE OF AIRCRAFT	FUNCTION	FREQUENCY
C-5	Logistics	1/month
C-9	Medical/Evacuation	2/week
C-141	Logistics	2/week
KC-135A	Refueling	1/month
T-38	USAF Trainer	2/week
T-39	Command Support	4/week
DC-9	Logistics - Air	1/day
727	Logistics - Air	1/day

2752

Table 3.2-3. Summation of projected and/or expected aircraft frequency of daytime and nighttime operations for each operating base (airport).

TYPE OF AIRCRAFT	NO. OF ENGINES	TAKEOFFS		LANDINGS		CLOSED-PATTERN[2] OPERATION
		DAY[1]	NIGHT[1]	DAY[1]	NIGHT[1]	
E-3A/707	4	2	1.43	2	1.43	0
CH-53E (Helicopter)	3	6	2	6	2	0
C-5	4	0.03	0	0.03	0	0
C-9	3	0.26	0	0.26	0	0
C-141	4	0.26	0	0.26	0	0
KC-135A	4	0.03	0	0.03	0	0
T-38	1	0.13	0.13	0.13	0.13	0.13 Day 0.13 Night
T-39	2	0.26	0.26	0.26	0.26	0
DC-9	2	0.50	0.50	0.50	0.50	0
727	3	0.50	0.50	0.50	0.50	0

2753

[1]Day 0700 to 2200 hours; night 2200 to 0700 hours.

[2]Closed pattern refers to non-normal runway approach. These approaches are normally associated with fighter aircraft and are commonly referred to as "combat" approaches.

The Users Guide suggests in paragraph 2.5 "TOTAL TRAFFIC MIX" on page 2-18 that in cases where the number of operations of some aircraft types are small compared to others, the small numbers can be combined into representative types without substantive loss of accuracy. Likewise in paragraph 2.4 "FLIGHT TRACK DEFINITIONS" on page 2-14, it states that for simplicity, flight tracks used only in exceptional situations - such that the average usage is lower than one flight per day - are generally not defined.

An analysis of the types of aircraft frequency of daily flights as shown in the preceeding table shows that the major amount of airfield activity is done with aircraft which have either three or four engines. Based on this all aircraft with three or less engines are considered as having three engines.

The noise impact from the three-engine CH-53E helicopter is assumed equivalent to a four-engine jet for this noise analysis due to the lack of specific noise data for the aircraft. This is a conservative assumption. The flexibility of helicopter approaches and takeoffs provide a further degree of conservatism to the results. Unusual flight patterns are limited to less than one flight per day. Therefore all approach and takeoff flight patterns are assumed to be straight in and straight out.

For this noise analysis the four-engine aircraft are assumed to be equivalent in noise generation to a Boeing 707-320B and the three-engine aircraft to a Boeing 727-200, both fully loaded. The takeoff procedure is assumed to be equivalent to a standard "ATA take off" and the landing a "maximum certificated flap landing, 3^{o} glide slope;" both are part of the model program's standard library.

Table 3.3-1 is a summation of the parameter, factor and assumption information used for the noise modeling for the airfields. This information along with the specific information applicable to the airfields was fed into the computer and resulted in the noise level curves which follow.

3.4 NOISE PLOT RESULTS

Figures 3.4-1 through 3.4-7 are U.S.G.S. maps with the noise contours, proposed operating bases and airfields superimposed on the maps. The shaded area shows where the L_{dn} is greater or equal to 65. The maps show the population areas, ranches, and farms, along with the airfield approach zones. Because the flight tracks are assumed to be straight for both takeoffs and landings, the noise contours are rectangular. The contour extends approximately 5.9 mi from the end of the runway and is approximately 0.8 mi wide.

As can be seen on the maps, care was taken in selecting sites for the proposed operating bases and airfields so as to avoid creating noise impacts on any but a few scattered ranches and farms.

An alternative approach to noise impact assessment involves development of noise exposure forecast (NEF) contours. The NEF is a technique used by HUD for preliminary noise assessments. Although the preliminary NEF-30 contours shown on the base layouts are greater in aerial extent than the L_{dn} 65 contour, the NEF-30 contour is based on a relatively crude technique and does not reflect the limited frequency of anticipated takeoffs and landings. The NEF-30 analyses does, however, present a worst case noise contour.

Table 3.3-1. Summation of parameters, factors, and assumptions used for each airfield for noise modeling.

AIRCRAFT	OPERATION	AIRCRAFT[1] CONS.	NO. OF DAYTIME OPERATIONS	NO. OF NIGHTTIME OPERATIONS	TYPE OF APPROACH/ DEPARTURE	USE OF RUNWAYS
4-Engine	Takeoff	B258	8.32	3.43	Straight	Equal
	Landing	B259	8.32	3.43	Straight	Equal
3-Engine	Takeoff	B235	1.65	1.39	Straight	Equal
	Landing	B236	1.65	1.39	Straight	Equal

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[1]From Table B-1, Pages B-1 through 8 of FAA Interdated Noise Model Users Guide, FAA Report No. PAA-EQ-76-2, dated March, 1976, U.S. Department of Commerce Bulletin No. AD-A035 062, dated March, 1976.

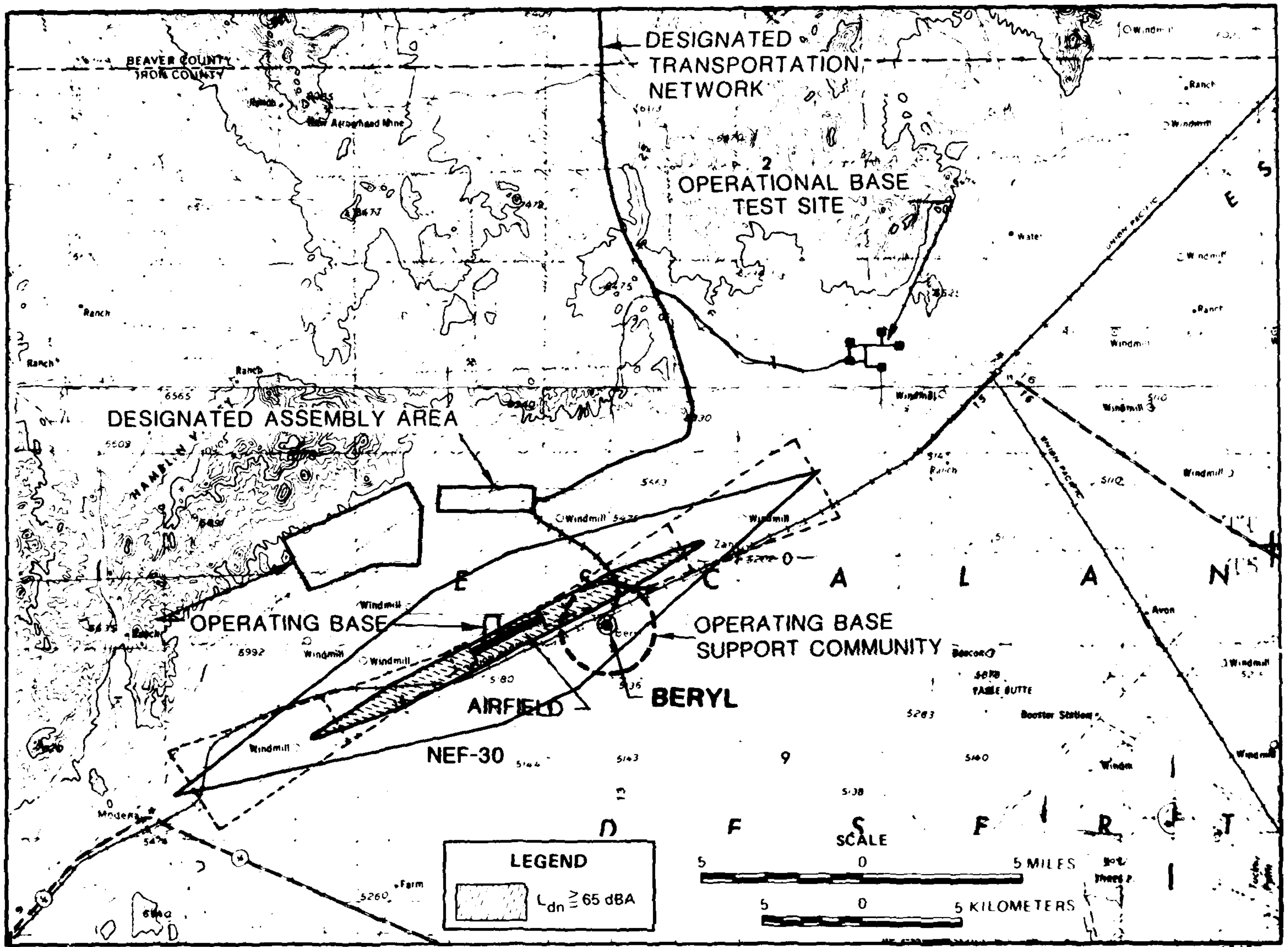

Figure 3.4-1. Airport noise contour, Beryl, Utah.

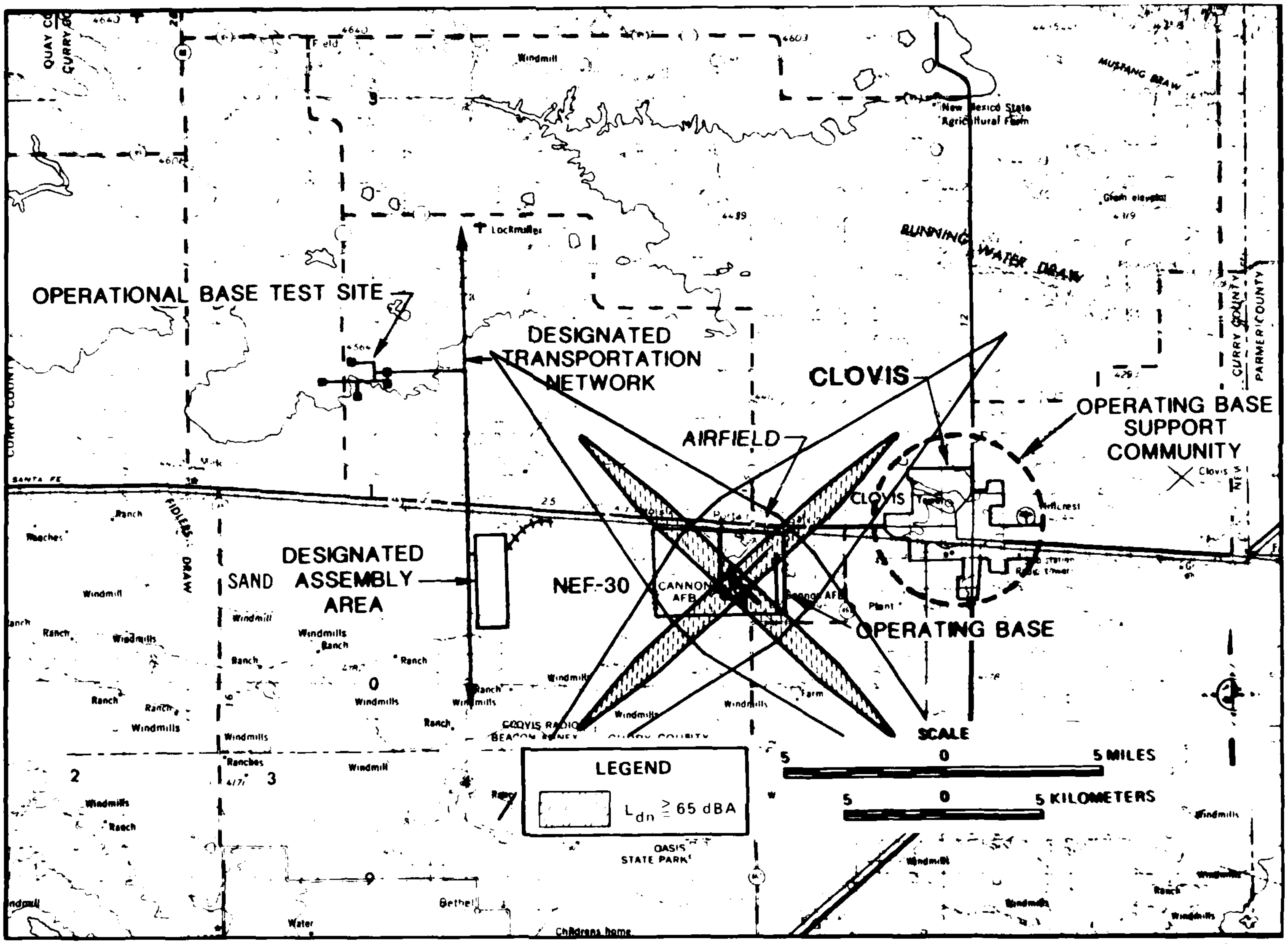

Figure 3.4-2. Airport noise contour, Clovis, New Mexico.

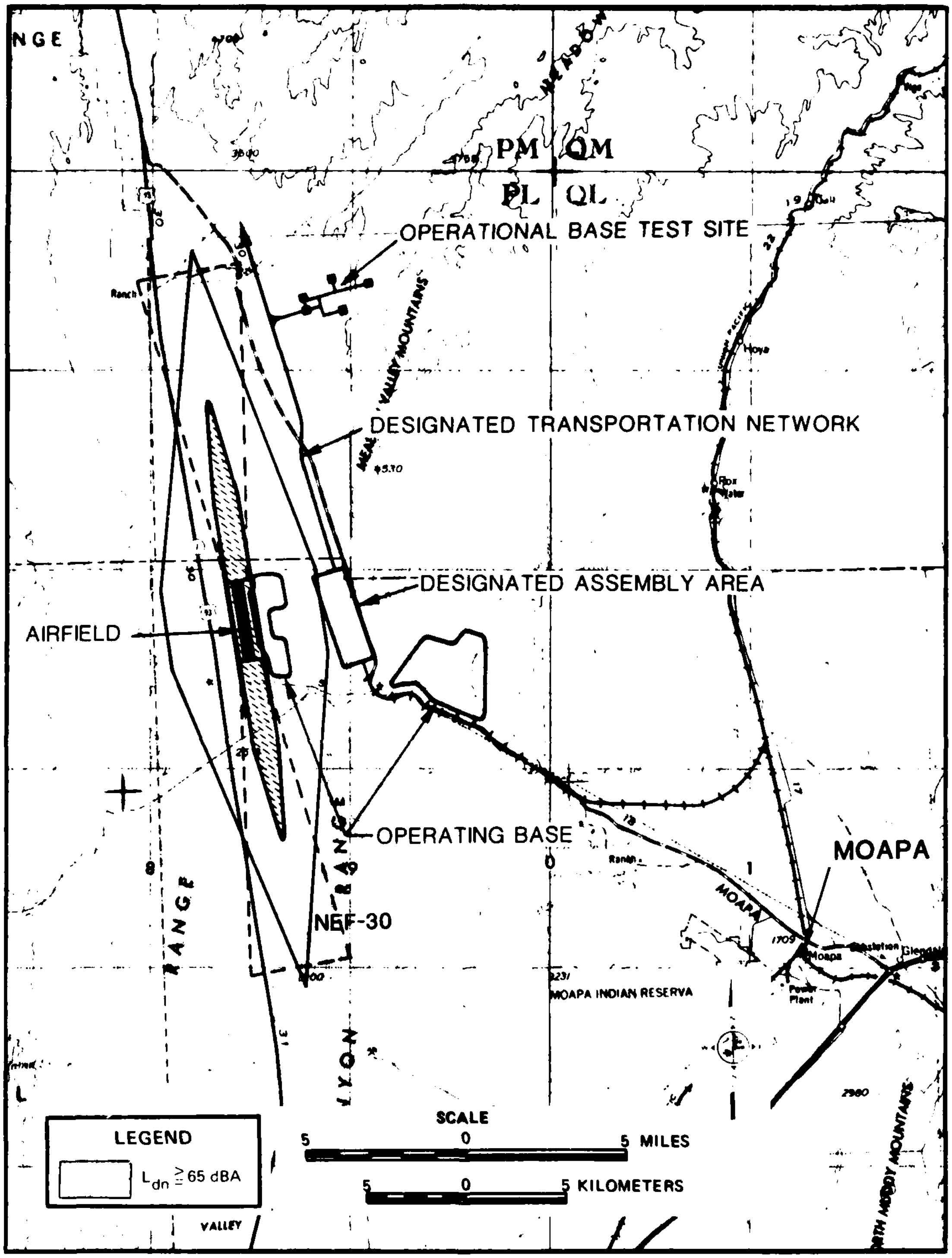

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Figure 3.4-3. Airport noise contour, Coyote Spring Valley, Nevada.

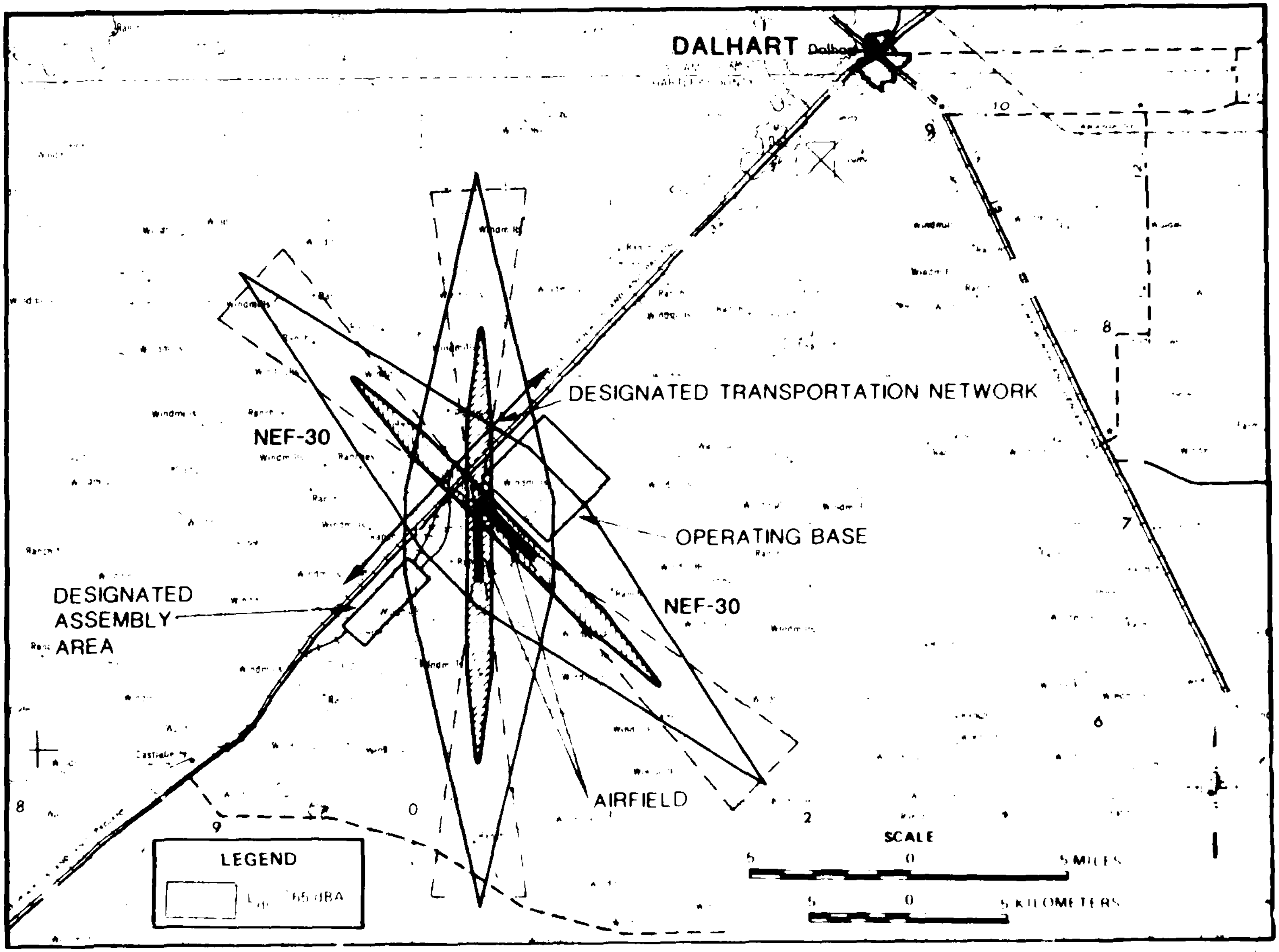

Figure 3.4-4. Airport noise contour, Dalhart, Texas.

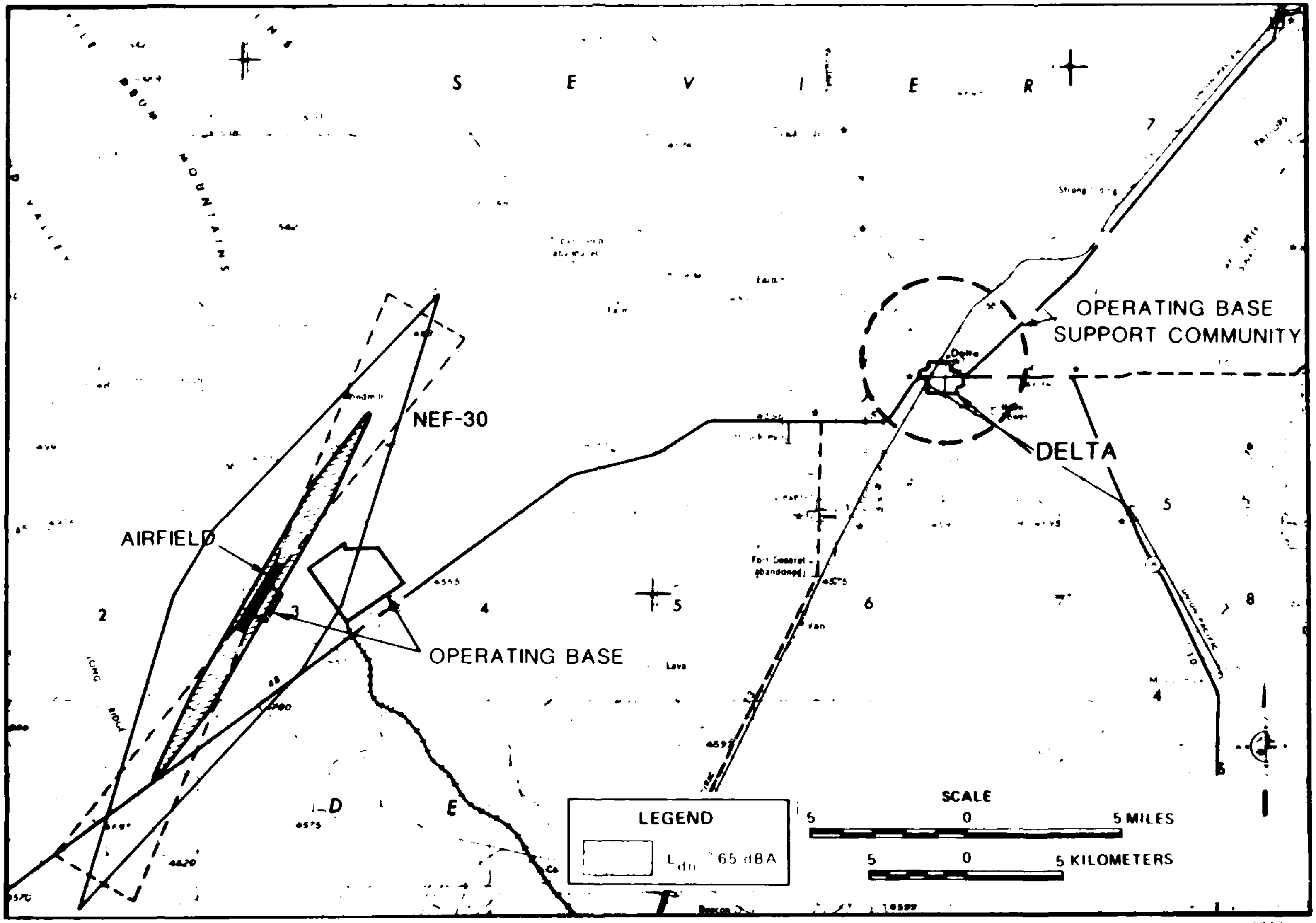

Figure 3.4-5. Airport noise contour, Delta, Utah.

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2559 B 1

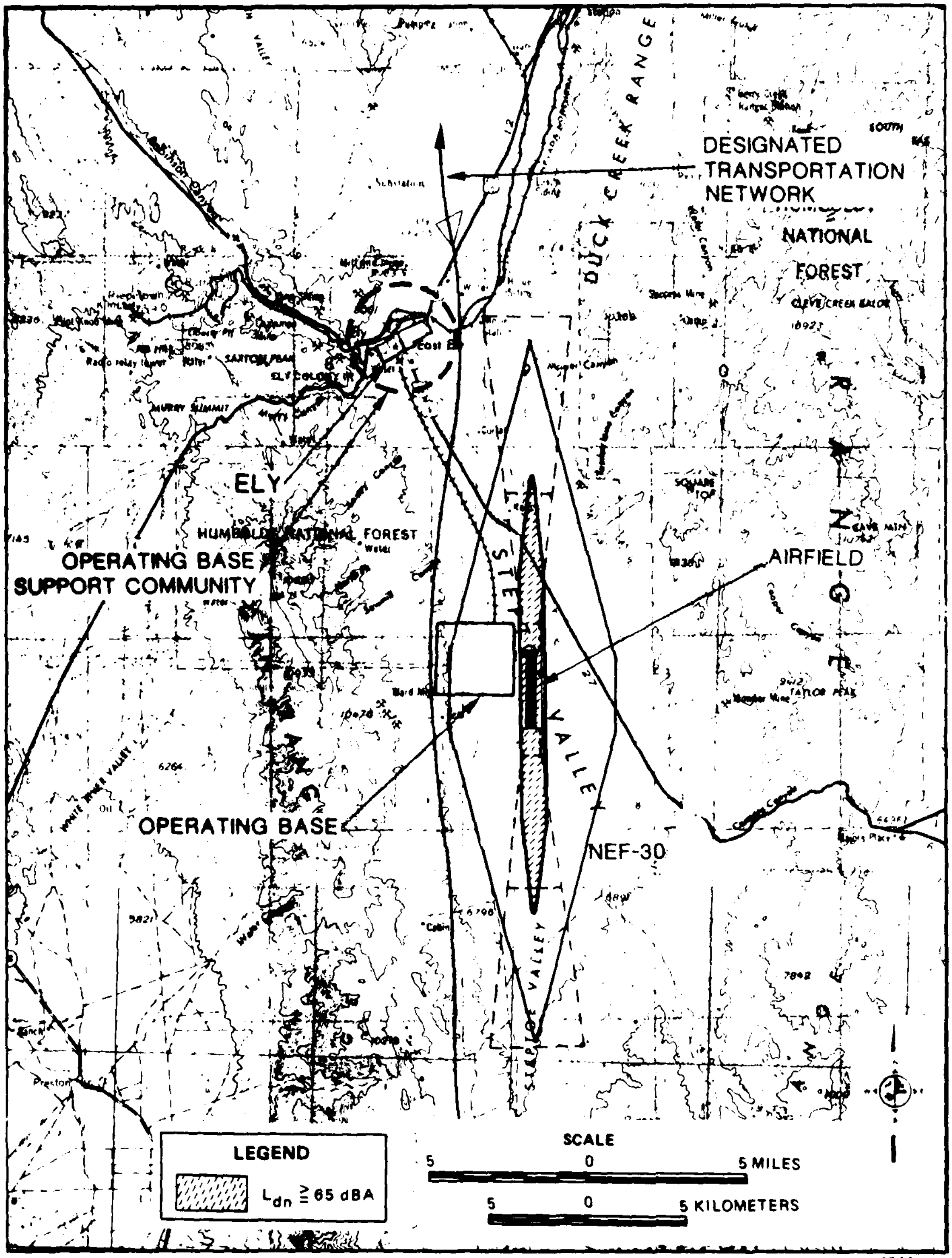

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Figure 3.4-6. Airport noise contour, Ely, Nevada.

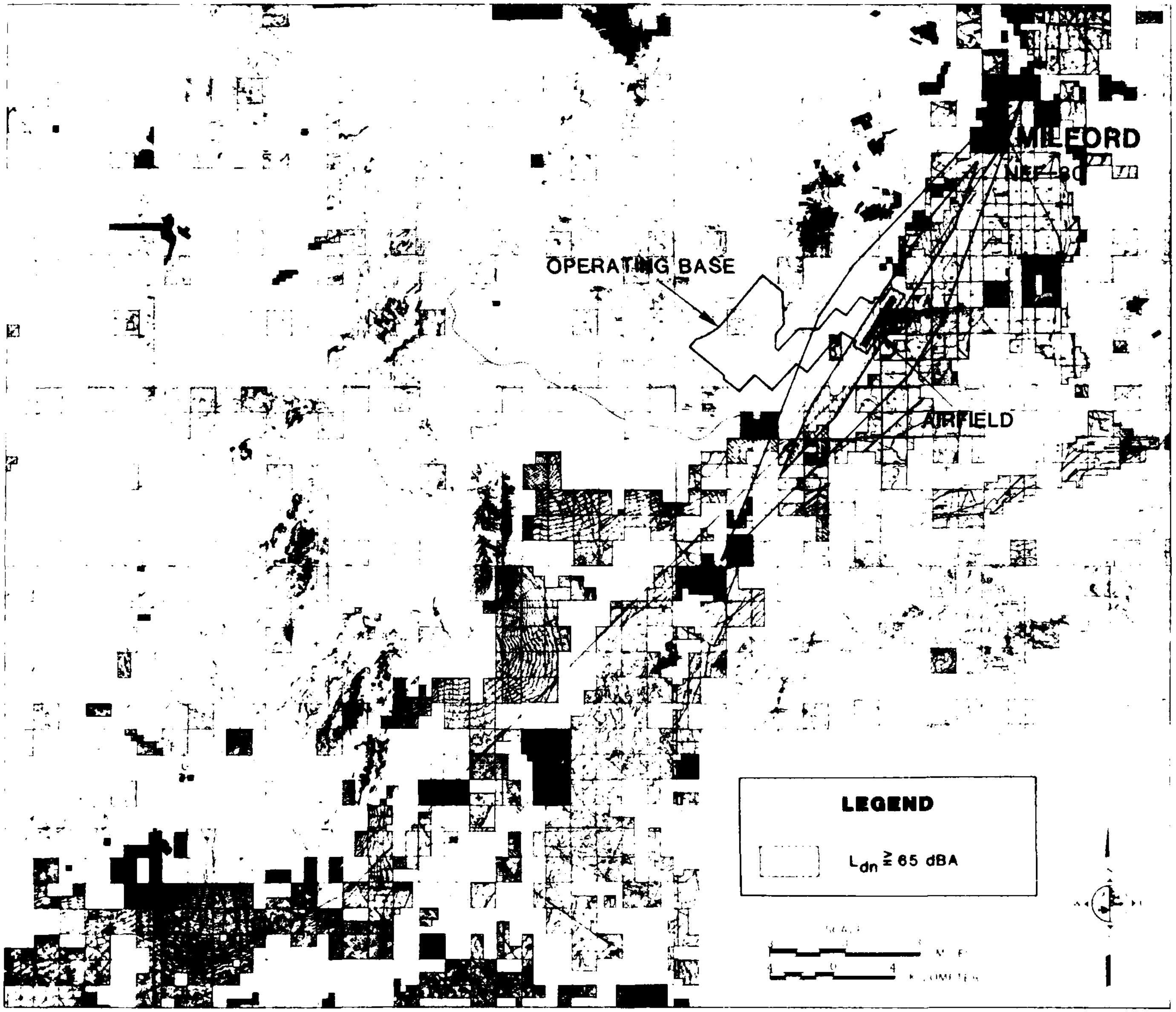

Figure 3.4-7. Airport noise contour, Milford, Utah.

BERYL, UTAH - ALTERNATIVES 1, 3 AND 4. The aircraft noise contour plot for the area surrounding the proposed operating base airfield at Beryl, Utah is shown in Figure 3.4-1. There appear to be no farms within the L_{dn} 65 and greater contour.

CLOVIS, NEW MEXICO - ALTERNATIVES 7 AND 8. The aircraft noise contour plot for the area surrounding the proposed operating base airfield at Clovis, New Mexico is shown on Figure 3.4-2. There are several farms and one small town center possibly affected by the noise level zone. It is proposed to use the Cannon Air Force Base for the operating base airfield. Minimal increased sound levels would be expected from the proposed additional aircraft operations. As discussed earlier, superimposing sound levels only increases the overall sound level by at most 3 dB over the louder contributing sound level. (The noise contour in the figure does not include existing aircraft operation.)

COYOTE SPRING VALLEY, NEVADA - PROPOSED ACTION AND ALTERNATIVES 1, 2, 4, 6, AND 8. The aircraft noise contour plot for the area surrounding the proposed operating base airfield at Coyote Spring, Nevada, is shown on Figure 3.4-3. There appear to be no affected land users.

DALHART, TEXAS - ALTERNATIVE 7. The aircraft noise contour plot for the area surrounding the proposed operating base airfield at Dalhart, Texas, is shown on Figure 3.4-4. There appear to be two or three ranches which may be affected.

DELTA, UTAH - ALTERNATIVE 2. The aircraft noise contour plot for the area surrounding the proposed operating base airfield at Delta, Utah, is shown on Figure 3.4-5. There appear to be no affected land users.

ELY, NEVADA - ALTERNATIVE 5. The aircraft noise contour plot for the area surrounding the proposed operating base airfield at Ely, Nevada, is shown on Figure 3.4-6. There appear to be no affected land users.

MILFORD, UTAH - PROPOSED ACTION, ALTERNATIVES 5 AND 6. The aircraft noise contour plot for the area surrounding the proposed operating base airfield at Milford, Utah is shown in Figure 3.4-7.

3.5 AIRFIELD DESIGN MITIGATIONS

The proposed airfield locations and design are such that a minimum of noise impact would result to the environment. In all cases, the airfields are proposed to be located in sparsely populated areas, except for the Clovis, New Mexico, base where the Cannon Air Force Base would be used.

The orientation of the airfields is such that the approach and departure routes are directed, wherever possible, away from residential, farming, and ranching areas.

During takeoffs and landings at the operating base airfields, there will be unavoidable noise impacts. This effect is small due to the placement of the airfields in sparsely populated remote areas and residential, farming, and ranch areas.

Note that the above calculations are very conservative, since (1) the actual noise impact of the CH-53 helicopter is significantly less than that of the B-707, and (2) the INM-data base assumes 70 percent relative humidity, resulting in substantially lower atmospheric sound absorption than would normally be experienced in the dry desert climate.

4.0 SUMMARY AND CONCLUSIONS

4.1 TRAFFIC STUDY

At the level of detail of the study, it does not appear that noise generation and impact will be of major importance in selecting an alternative system. This is due to the sparse population distributions and relatively low volumes of traffic on the highways. Detailed field studies are necessary during Tier 2 studies to document existing conditions and the number of land users potentially affected. In areas where impacts to residential communities are significant, noise mitigation techniques could be employed. Impact on humans in the deployment area will be minimal both during and after construction. Impact on animals cannot be determined at this time.

Railroad noise impact will be small because of the very limited increase of railroad activity during the peak construction period.

4.2 AIRPORT STUDY

The alternative operating base airfields are all proposed to be located in remote sparsely populated areas, with the exception of Clovis, New Mexico (Cannon Air Force Base), which is an operating Air Force training base. The analysis shows that there is no significant noise impact on present land users.

It is concluded that any of the alternative operating base sites would be satisfactory with regard to noise impact. The only effect would be to prevent the development of noise sensitive projects in the impacted area in the vicinity of the runways.

APPENDIX A

SUBJECTIVE NOISE CRITERIA

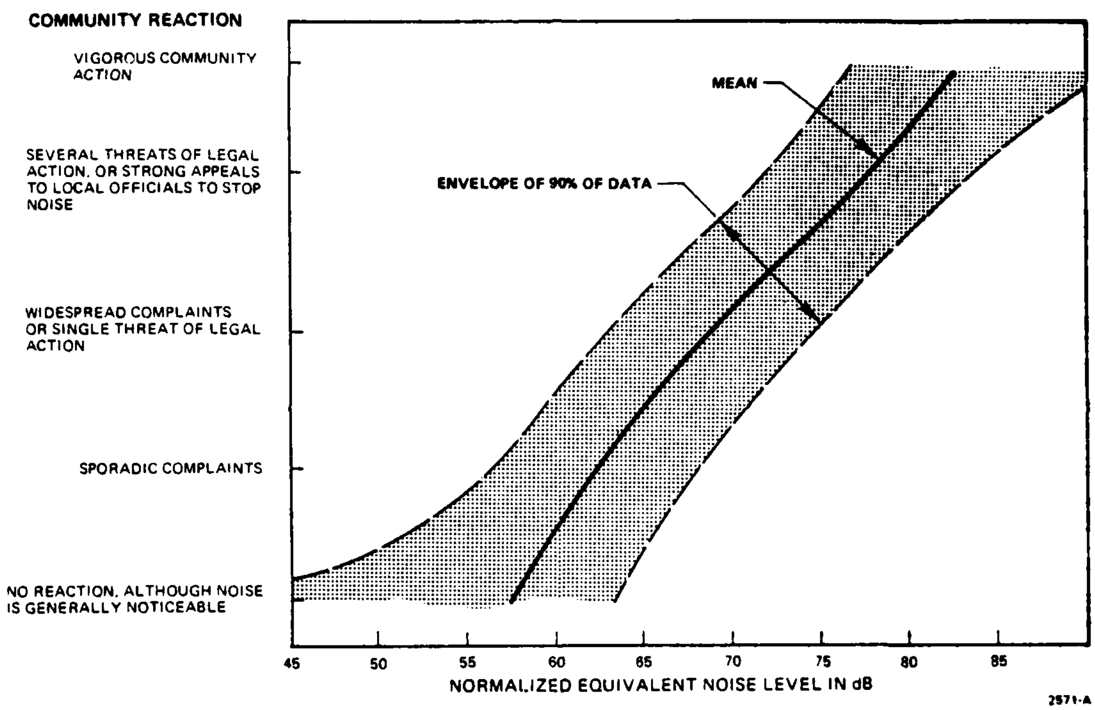

Figure A-1. Community reaction to intrusive noise (source: EPA, NTID 300.3, pg. 63).

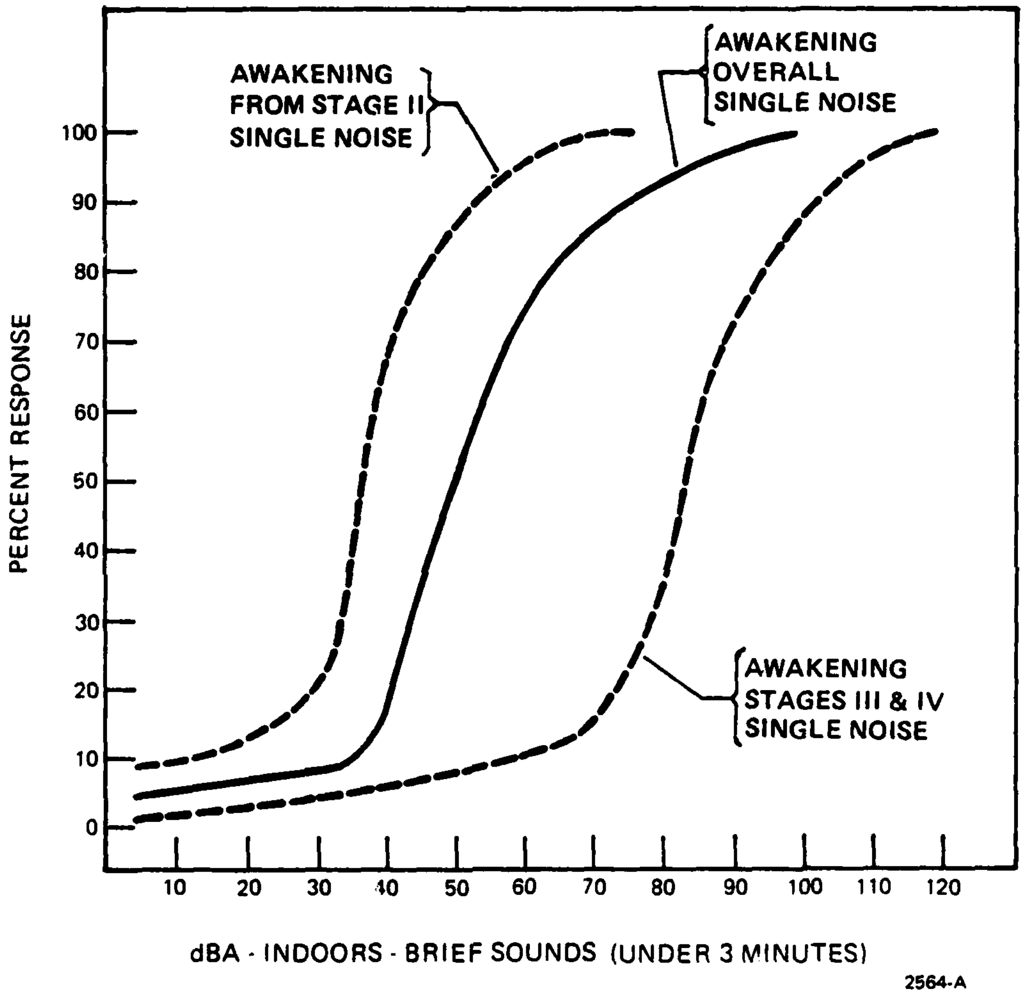

Figure A-2. Sleep interference as a function of intruding noise level for normally rested young adults, unacclimated.

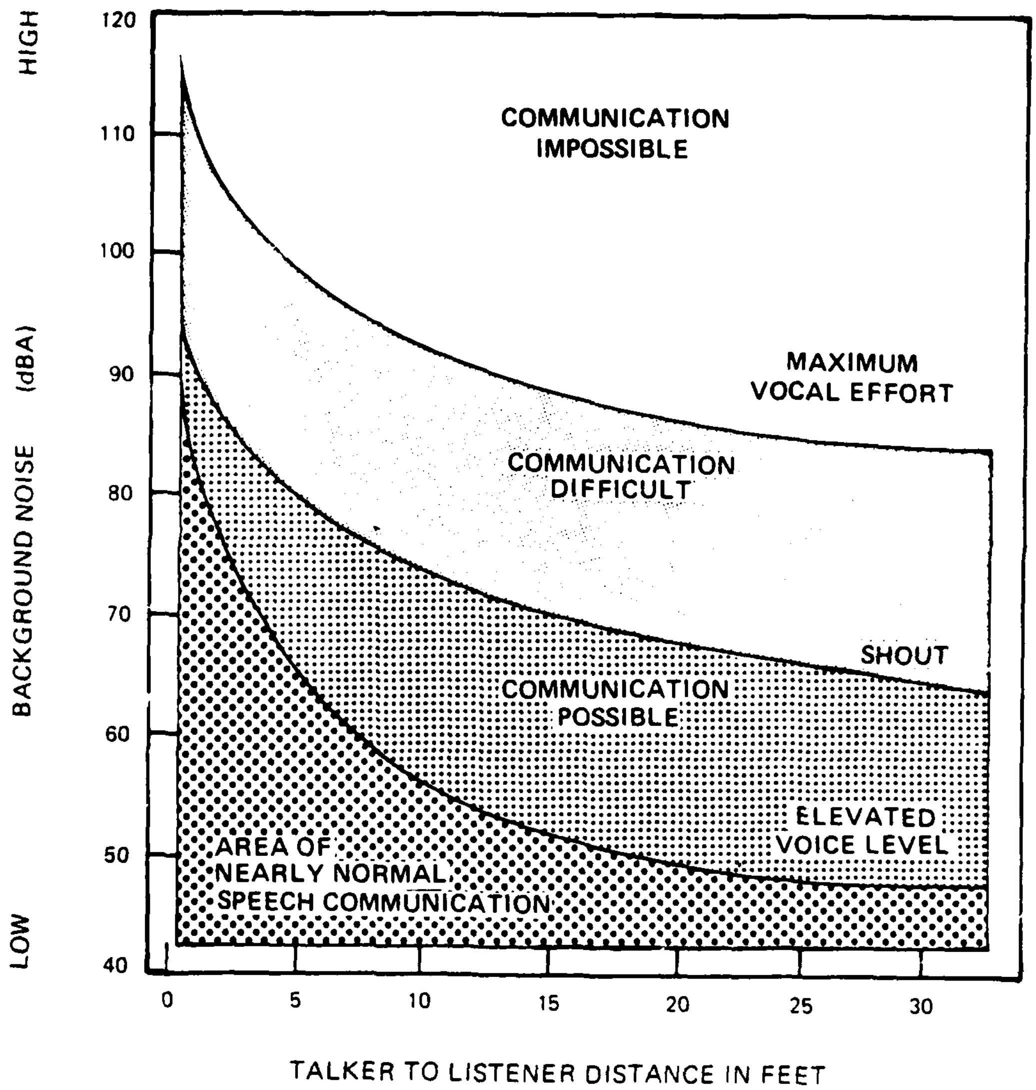

Figure A-3. Quality of speech communication in relation to distance between talker and listener (source: Oxnard Noise Element of General Plan).

APPENDIX B

DEFINITIONS

APPENDIX B

DEFINITIONS

1. Decibel (dB) - A unit division on a logarithmic scale whose base is the 10th root of 10, used to represent ratios of quantities proportional to power.

2. Sound Pressure Level (SPL - dB) - Operationally,

$$SPL = 20 \times \log (P/Pref)$$

where P is the root mean square sound pressure.

3. A-weighted sound level (SLA - dBA) - Sound pressure level measured using the A-weighting network, a filter which discriminates against low and very high frequencies similar to the human hearing mechanism at moderate levels (ref. ANSI S1.4 - 1961).

4. Equivalent Sound Level (L_{eq}) - The sound level averaged on a power basis over a specified time period.

5. Percentile exceeded sound levels (L_x) - The sound level which is exceeded x percent of a specified time period.

6. Day Night Average Sound Level (L_{dn}) - The long-term sound level, averaged on a power basis, and weighted as follows:

   a. Frequency response is filtered using the A-weighting network.
   b. Sounds occurring between 2200 and 0700 hours are weighted by + 10 dB.

7. Sound Exposure Level (SEL) - The sound level of one second duration producing the same acoustic energy as a single event of varying level and arbitrary duration.
   Operationally,
   $SEL = L_{eq\ event} + 10 \times \log$ (duration in seconds)
   $SEL = L_{max\ event} + 10 \times \log$ (effective duration in seconds).

   where the "duration" is the actual time over which L_{eq} was determined and "effective duration" is the length of an event of constant sound pressure level equal to the maximum level of the time varying event and which produces the same total acoustic energy as the time varying event.

APPENDIX C

LAND USE COMPATIBILITY GUIDELINES

Table C-1. Land use compatibility guide-lines. (Page 1 of 8)

LAND USE CATEGORY	COMPATIBLE USE DISTRICTS				
	L_{dn} 85	L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70
<u>RESIDENTIAL</u>					
Single Family	N	N	N	30[2]	30[2]
Two Family	N	N	N	30[2]	25[2]
Multifamily Dwelling	N	N	N	30[2]	25[2]
Group Quarters	N	N	N	30[2]	25[2]
Residential Hotels	N	N	N	30[2]	25[2]
Mobil Home Parks or Courts	N	N	N	30[2]	25[2]
Transient Lodging-Hotels, Motels	N	N	35[2]	30[2]	25[2]
Other Residential	N	N	N	30[2]	25[2]
<u>INDUSTRIAL/MANUFACTURING</u>[3]					
Food and Kindred Product	N	Y[4]	Y[5]	Y[6]	Y
Textile Mill Products	N	Y[4]	Y[5]	Y[6]	Y
Apparel	N	Y[4]	Y[5]	Y[6]	Y
Lumber and Wood Products	N	Y[4]	Y[5]	Y[6]	Y
Furniture and Fixtures	N	Y[4]	Y[5]	Y[6]	Y
Paper and Allied Products	N	Y[4]	Y[5]	Y[6]	Y
Printing, Publishing	N	Y[4]	Y[5]	Y[6]	Y
Chemicals and Allied Products	N	Y[4]	Y[5]	Y[6]	Y
Petroleum Refining and Related Industries	N	Y[4]	Y[5]	Y[6]	Y

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Table C-1. Land use compatibility guidelines. (Page 2 of 8)

LAND USE CATEGORY	COMPATIBLE USE DISTRICTS				
	L_{dn} 85	L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70
INDUSTRIAL/MANUFACTURING[3]					
Rubber and Miscellaneous Plastic	N	Y[4]	Y[5]	Y[6]	Y
Stone, Clay and Glass Products	N	Y[4]	Y[5]	Y[6]	Y
Primary Metal Industries	N	Y[4]	Y[5]	Y[6]	Y
Fabricated Metal Industries	N	Y[4]	Y[5]	Y[6]	Y
Professional, Scientific and Controlling Instruments	N	N	30	25	Y
Miscellaneous Manufacturing	N	Y	Y[5]	25	Y
TRANSPORTATION, COMMUNICATIONS AND UTILITIES					
Railroad, Rapid Rail Transit	Y	Y	Y	Y	Y
Highway and Street ROW	Y	Y	Y	Y	Y
Auto Parking	N	Y	Y	Y	Y
Communication (noise sensitive)	N	N	30	25	Y
Utilities	Y	Y	Y	Y	Y
Other Trans, Comm, and Utilities	Y	Y	Y	Y	Y

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Table C-1. Land use compatibility guidelines. (Page 3 of 8)

LAND USE CATEGORY	COMPATIBLE USE DISTRICTS				
	Ldn 85	Ldn 80-85	Ldn 75-80	Ldn 70-75	Ldn 65-70
COMMERCIAL/RETAIL TRADE					
Wholesale Trade	N	Y[4]	Y[5]	Y[6]	Y
Building Materials-Retail	N	Y[4]	Y[5]	Y[5]	Y
General Merchandise-Retail	N	N	30	25	Y
Food-Retail	N	N	30	25	Y
Automotive, Marine	N	N	30	25	Y
Apparel and Accessories Retail	N	N	30	25	Y
Eating and Drinking Places	N	N	30	25	Y
Furniture, Home Furnishing Retail	N	N	30	25	Y
Other Retail Trade	N	N	30	25	Y
PERSONAL AND BUSINESS[4] SERVICES					
Finance, Insurance & Real Estate	N	N	30	25	Y
Personal Services	N	N	30	25	Y
Business Services	N	N	30	25	Y
Repair Services	N	Y[4]	Y[5]	Y[6]	Y
Contract Construction Services	N	N	30	25	Y

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Table C-1. Land use compatibility guidelines. (Page 4 of 8)

LAND USE CATEGORY	COMPATIBLE USE DISTRICTS				
	L_{dn} 85	L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70
PERSONAL AND BUSINESS SERVICES[8]					
Indoor Recreation Services	N	N	30	25	Y
Other Services	N	N	30	25	Y
PUBLIC AND QUASIPUBLIC SERVICES					
Government Services	N	N	30	25	Y
Educational Services	N	N	N	30	25
Cultural Activities (including churches)	N	N	N	30	25
Medical and Other Health Services[9]	N	N	N	30	25
Cemeteries	Y	Y[4]	Y[5]	Y[6]	Y
Nonprofit Organization	N	N	N	30	25
Other Public and Quasipublic Services	N	N	N	30	25
OUTDOOR RECREATION					
Playgrounds, Neighborhood Parks	N	N	N	Y	Y
Community and Regional	N	N	N	Y[11]	Y

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Table C-1. Land use compatibility guidelines. (Page 5 of 8)

LAND USE CATEGORY	COMPATIBLE USE DISTRICTS				
	L_{dn} 85	L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70
OUTDOOR RECREATION (cont)					
Nature Exhibits	N	N	N	N	Y
Spectator Sports Including Arenas	N	N	N	N	Y
Golf Course[12], Riding Stables[13]	N	N	Y[14]	Y[15]	Y
Water Based Recreational Areas	N	N	Y[14]	Y[15]	Y
Resort and Group Camps	N	N	N	Y	Y
Auditoriums, Concert Halls	N	N	N	N	Y
Outdoor Amphitheaters, Music Halls	N	N	N	N	N
Other Outdoor Recreation	N	N	N	Y	Y
RESOURCE PRODUCTION, EXTRACTION, AND OPEN SPACE					
Agriculture (except livestock)	Y[17]	Y[17]	Y[17]	Y[18]	Y[19]
Livestock Farming, Animal Breeding	N	N	Y[17]	Y[18]	Y[19]
Forestry Activities	Y[17]	Y[17]	Y[17]	Y[18]	Y[19]

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Table C-1. Land use compatibility guidelines. (Page 6 of 8)

LAND USE CATEGORY	COMPATIBLE USE DISTRICTS				
	L_{dn} 85	L_{dn} 80-85	L_{dn} 75-80	L_{dn} 70-75	L_{dn} 65-70
<u>RESOURCE PRODUCTION EXTRACTION, AND OPEN SPACE</u> (cont)					
Fishing Activities and Related Services	Y	Y	Y	Y	Y
Mining Activities	Y	Y	Y	Y	Y
Permanent Open Space	Y	Y	Y	Y	Y
Water Areas	Y	Y	Y	Y	Y

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Table C-1. Land use compatibility guidelines--notes. (Page 7 of 8)

N (NO)	- The land use and related structures are not compatible and should be prohibited.
Y (YES)	- The land use and related structures are compatible without restriction and should be considered.
Y^x (YES WITH RESTRICTIONS)	- The land use and related structures are generally compatible; however, some special factors should be considered.
35,30 or 25	- The land use is generally compatible; however, a Noise Level Reduction of 35, 30 or 25 must be incorporated into the design and construction of the structure.
35^x, 30^x or 25^x	- The land use is generally compatible with NLR: however, such NLR does not necessarily solve noise difficulties and additional evaluation is warranted.
1	- Because of accident hazard potential, the residential density in these CUD's should be limited to the maximum extent possible. It is recommended that residential density not exceed one dwelling unit per acre. Such use should be permitted only following a demonstration of need to utilize this area for residential purposes.
2	- Although it is recognized thatlocal conditions may require residential uses in these CUD's, this use is strongly discouraged in CUD's 10 and 12 and discouraged in CUD's 11 and 13. The absence of viable alternative development options should be determined and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these CUD's should be conducted prior to approvals. Where the community determines that residential uses must be allowed Noise Level Reductions (NLR) of at least 30 (CUD's 10 and 12) and 25 (CUD's 11 and 13) should be incorporated into building codes and/or individual approvals. Additional consideration should be given to modify the NLR levels based on peak noise levels. Such criteria will not eliminate outdoor environment noise problems and, as a result, site planning and design should include measures to minimize this impact particularly where the noise is from ground level sources.

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Table C-1. Land use compatibility guidelines--notes. (Page 8 of 8).

3	- Because these uses vary considerably by locality and within a general category, particular care should be taken to evaluate and modify guidelines to fit local conditions. Among factors to be considered: labor intensity, structural coverage explosive inflammable characteristics, size of establishment, people density, peak period (including shopper/ visitors) concentrations.
4	- A NLR of 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas or where the normal noise level is low.
5	- A NLR of 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas or where the normal noise level is low.
6	- A NLR of 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas or where the normal noise level is low.
7	- No structures in Clear Zone, no passenger terminals, and no major ground transmission lines in Clear Zones or APZ I.
8	- Low intensity office uses only (limited scale of concentration of such uses), meeting places, auditoriums, etc. not recommended.
9	- Excludes hospitals.
10	- Excludes chapels.
11	- Facilities must be low intensity.
12	- Clubhouse not recommended.
13	- Concentrated rings with large classes not recommended.
14	- A NLR of 30 must be incorporated into buildings for this use.
15	- A NLR of 25 must be incorporated into buildings for this use.
16	- No structures in Clear Zone.
17	- Residential structures not permitted.
18	- Residential buildings require a NLR of 30.
19	- Residential buildings require a NLR of 25.

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REFERENCES

L. Beranek, ed. "Noise Vibration and Control", McGraw-Hill, N.Y., 1971 p. 171,186.

C.G. Gordon et al. "Highway Noise - A Design Guide for Highway Engineers," NCHRP Report 117, 1971.

C.M. Harris, "Handbook of Noise Control", McGraw-Hill Book Company, N.Y. 1979.

P.A. Mansbach et al., "FAA Integrated Noise Model User's Guide," U.S. Department of Transportation, Federal Aviation Administration, Report FAA-EQ-76-2, 1976.

"FHWA Level 2 Highway Traffic Prediction Model," FHWA-RD-78 - Draft, July 1978.

"Noise from Construction Equipment and Operations, Building Equipment and Home Appliances," NTID 300.1, U.S. EPA, Washington, D.C., 1979.

"Community Noise," NTID 300.3, U.S. EPA, Washington, D.C., Dec. 31, 1971, p. 63, Figure 25.

"Environmental Impact Statement Guidelines," EPA Region X, April" 1973.

AICUZ Part 256 of Title 32 of the Code of Federal Regulations, 42 Fed. Reg. 773, Jan. 4, 1977.

"Noise Element of the General Plan for the City of Oxnard, CA.," Olson Lab., Inc., Jan. 1978, p. 18 Figure 4.

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